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EDUCATING THE SCIENCE TEACHER TO USE COMMUNITY RESOURCES

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The position which we as science teachers shall take with respect to centering learning activities in our communities depends upon the purpose we accept to guide our work. As points of departure in this discussion we may present two contrasting purposes or points of view. In the first a teacher may say, "My purpose is to teach science." In his work with young people this teacher will be guided by the thought that science is organized knowledge from which subject matter to be learned will be selected. In the usual method of high school teaching the textbook is used more or less as a guide for the teacher as he plans his work. The teacher following this plan may hold rigidly to textbook assignments or may exercise his own originality and prepare his own outlines. In any case the purpose in his work is to teach elements of organized science accepted or selected by the teacher as important for young people to learn.

In a chemistry course, for example, attention will be centered upon chemical changes. The work of the students is directed toward study of the chemical elements often following a sequence suggested in part by the order in which the elements occur in the periodic table. The organization of knowledge followed in a course in chemistry is similar to the organization that was followed in classifying scientific facts as they were discovered. The more versatile science teacher will be able to set situation within which his special-interest students will identify challenging problems. It may be argued that this is a proper procedure when the purpose is to educate for a career in chemistry.

As an alternative to the position described, a teacher may say, "My purpose is to set situations within which young people may identify and deal with their personal problems." In this case selections of learnings to be sought and of materials to be used in the learning process are made with reference to present interests and necessary tasks of students and teachers. These will be discoverd in the activities necessary to maintaining one's place in the community and in the social organization. They will include use of resources; advancement of industry; maintenance of personal and public health; adjustment to customs, feelings and folklore of people; and relations within the home and family, including love and courtship, growth and development of children, and maturing and aging of adults. Some of these things may be more closely related to the competence and interests of science teachers than others but since influences from scientific work have permeated so extensively into the thoughts and actions of people, the qualified science teacher may contribute significantly to many or all of the broad questions that arise in day to day activities.

The essential difference in the work of the two teachers previously described is that the first directs his students to study mainly from the record of human achievements; the second, in cooperation with his students, selects the materials to be used

in learning with reference to the community and to present interests and necessary tasks. Teachers are generally not altogether like the first nor like the second. Good teachers may have some of the qualities of both. The extent to which the teacher will relate his work to the community will depend largely on the degree to which he shifts in his thinking away from the pattern of the first teacher in the direction of the pattern of the second.

In general, the goal of education as an established institution is to contribute through the work of teachers to the betterment of life. This betterment is gained as men learn to realize more successfully their biologically and culturally determined needs and desires. In following the interests that spring from these needs and desires we, collectively, strive to achieve in our society a pattern of organization within which every person is permitted freedom to work toward what he thinks are his needs. This freedom is, we believe, in agreement with the ideals of democracy.

Obviously there are opposing patterns of educational theory to support these contrasted ways of working. The underlying theory of the first is that we learn from teacher-selected elements of the cultural heritage and consequently students are told in assignments what they are to learn. Following this assumption the teacher assigns problems that have been solved and to which the answers are well known. He requires students to work through the solutions of assigned problems in order that they may be educated to deal independently with new problems as they arise. In this first method the center of attention in studies is a prepared assignment. In the approach of the second method described the teacher allows and encourages the student in their work with him, to deal with problems they themselves recognize as their own. This teacher takes the position that dealing with such problems afford the best education for dealing independently with all situations as they arise. In this second method the center of attention in studies are the issues and problems that arise in personal and group relations of community living. In the first method the study areas are chosen for the student and given as assignments from an area of specialization; in the second method the study areas are discovered by the students from within the broad field of personal and social action. The first method, in its origins, was designed for the education of specialists and may be described as special or subject-area education. The second method is more nearly in agreement with the concept of education for all, and may be described as general education.

The emphasis on general education, in agreement with the foregoing concept, has increased following reports on evaluation of results from subject-matter teaching. Careful studies have lent support to the conclusion that the usual methods of teaching science, and other subjects as well, have not been wholly successful and that students who take these courses are not gaining favorable attitudes toward science.

The American Youth Commission, during the thirties, studied and reported upon attitudes of young people toward their work in school. In these studies it was found, that in the opinion of the young men and women involved, they had been directed to do work in high school and in college that was useless to them. They were rcognizing that many of the tasks to which they had been assigned in school were nearly or completely unrelated to the tasks with which they were confronted in the normal course of their growth and development. These studies by the Commission, and others which followed, have been a stimulus to plan and carry on a new or different kind of education more suited to needs.

The term "general" has been used to describe the new emphasis. In this usage, education is general in the degree to which it has been planned with reference to total needs and interests. It is a commonplace to say that needs and interests of people stem from the responses they make to their surroundings. The recommendations emi-

nating from the Youth Commission Reports and from other sources, made with recognition of this relation between environment and response, have brought about many changes in the high school curriculum. More and more the purposes of high school education are being stated in terms of general education.

Following the plan of general education, the high school or college is to be seen as a regional institution deriving its objectives from the community it serves. The experiences through which people are educated and the character of their education is determined in large measure by the folklore and customs and traditions of the society in which they live. These are the determiners of ideals, attitudes, and standards of conduct; and in turn are definitive of the problems and issues of the people living in that society. General education will be comprehensive enough to encompass these problems and issues. Learning will be thought of as going on in the broad social setting of community living. The general education teachers will be thought of as cultured, well-adjusted and happy men and women, aware of the happenings around them, and, with interest and sincerity, playing their parts as members of society. *They will be people who in their own lives have achieved the objectives which the members of society in general have recognized as appropriate in the education of young people.*

What do the teacher and the young people with whom he works see as they look out at the community around them?

In one illustration * the biology teacher was discussing her health work with the school nurse. She was reminded by the nurse of the many health activities in which the young people were taking a part in their own homes. During the conversation the nurse agreed to keep records of observations made during her visits to the families and then to plan with the biology teacher and the students in her classes some things to do that seemed appropriate to the needs that were discovered. It was found, of course, that baby brothers and sisters were being born, that there were aged parents and grandparents, and younger people who were invalids or suffering from prolonged illness. Then there were colds, influenza, and the usual children's disease and the usual nutritional disorders. The school nurse reported on the use of many home remedies. The issues raised from these reports were seen as real problems for the students. Many students were carrying a large measure of responsibility for the care of some member of the family. All were concerned with community responsibility in matters related to home illnesses.

In this illustration the teacher and the nurse were happy in their work as they helped young people deal with home nursing situations. They were aware of the satisfactions the young people were deriving from dealing with issues that were of immediate concern to them. They could see that the learnings were useful to them now and that they would influence the students' lives as citizens in the years to come. They felt assured they would be remembered by their students for the part they played in planning for them rich educational experiences.

Another illustration is presented here in some detail. It illustrates a major effort to use science as a resource in dealing with issues selected by young people because they themselves had judged the issues to be important.

The work was done in a class which was listed in the catalog as "Physical Science." As a result of experiences during previous years, the course was in bad repute among students. The new teacher was challenged to carry on in such a manner that the work in this course would be accepted by the students as good education.

In an excellent usage of group process, involving students and teacher, the overall plans for the one year course were laid

* Described in, Laton, A. D. and Powers, S. R., *New Directions in Science Teaching*, New York: McGraw-Hill Book Company, Inc. 1949, p. 27.

out. The members of the group discovered questions and problems they thought were immediately important to them. Then they selected from these the ones that seemed appropriate for study in the environment of a physical sicence classroom. Related questions were grouped under topic headings. Methods of study to be used in answering questions were arrived at cooperatively. Some six major topics were selected. The teacher reported * in careful detail about the group study of housing.

The class was composed entirely of girls aged 19 to 25. A few were married, some were engaged to men in the Armed Forces, interest in housing was strong. With this discovery the teacher was challenged to gain for himself the orientation and understanding that would enable him to work effectively with his students. As part of his own preparation he did a careful study of local housing. As the planning went forward it was clear to the students and their teacher that the proposed study was important, and that all had common interests in it.

They were reminded in many experiences of the shortage and of the unsatisfactory condition of housing in this school community. This was a personal interest because many of them were anticipating building, buying, or renting. It was also recognized as important in community welfare. An outline for study was prepared by the class including the following items:

1. Is there a need for more and better housing?

This question suggested interviews with municipal authorities, real estate agents, the Chamber of Commerce, welfare and health organizations, and others. Outside speakers were invited, data were gathered from current publications, and first-hand data were gathered in the form of descriptions and photographs of housing within the community.

2. What housing is needed to meet existing needs?

There were questions about types of residential districts, zoning, and location with respect to transportation, communication and public utilities; the choice of a site with attention to type of soil and sub-soil, altitude, slope, and drainage; the kind of house to be chosen with attention to plans, size of family, and income. These questions led to laboratory projects in soil testing, water testing, and others; studies in the field (with assistance from the school geologist) of underlying rock formations, and studies of plans of "model" houses.

3. What determines choices of materials and methods of construction?

This led to study of many building materials; examination of construction methods; a description of what constitutes sound construction, with attention to basement and foundation, frame, sidewalk, floors and finish; and a special study of safety practices.

4. How are good heating and ventilating obtained?
5. What determines proper electric system and good lighting?
6. What are characteristics of a good plumbing system?
7. What factors determine the choice and maintenance of household appliances?

Presumably, the students felt strong motivation for their study. The questions raised were theirs, and in each instance the question had meaning in terms of their immediate experience and in terms of the broad social setting within which they lived.

A few illustrations of studies undertaken are briefly presented. (These descriptions are reported in the original manuscript in the language of the students who wrote them. The students' reports used in the following paragraphs have been slightly edited.)

* Blisard, Thomas J., *Developing Physical Science Experiences at Madison College,* (Harrisonburg, Virginia) *with Special Reference to Housing*. Teachers College, Columbia University, Doctor of Education Project (unpublished). 1949.

"Students studying the factors affecting the choice of the site found interesting information. According to the engineers and building construction men, over 80 per cent of the houses in the city had water running into cellars during rainy periods. These same experts disclosed that there was a rock shelf under a large part of the city close to the surface, and anyone buying a lot might find cost of excavation increased many times by necessity for dynamiting. The college geologist was consulted and samples of kinds of rock found in the area were identified and exhibited to the class. Students visited excavations under way and discussed these visits in relation to information supplied by the geologists. A report on the geology of the local area was located and used by the class. It was also reported that the top soil over the entire city had been lost through erosion when the area was farm land, hence, most of the building lots would require imported top soil for lawn and garden areas. Laboratory tests on soil and rocks were devised from materials students found in textbooks and carried on by the class during a laboratory period. The latter part of the period was used for a discussion of the results. Causes of erosion as well as methods of prevention and of restoration of the soil were studied. A group visited a soil restoration project in the county and reported to the class. . . .

"Various construction methods were described and illustrated with diagrams from building magazines. Laboratory experiments were devised to measure forces on braces and trusses placed at various angles. Visits to houses under construction and interviews with builders provided information on sizes and placement of supports, kinds of bridging, and methods of framing to minimize settling and distortion of buildings. Waterproofing of basements was given special attention due to local conditions. . . .

"The students (while) studying heating systems and ventilation, inspected different types of systems in available houses, set up model systems in the laboratory . . . to illustrate operation of hot air, hot water, and steam systems. Radiation from different surfaces was measured. Samples of fuels were analyzed and data from commercial fuel laboratories were obtained. Comparative costs of heating by use of different types of fuels were obtained from fuel dealers and home owners who had converted from the use of one fuel to another. A film explaining methods of heating homes were shown by one of the group. Relative humidity was measured experimentally in classroom, dormitories, and in homes using different kinds of heating systems. The operation of the thermostat was demonstrated in the laboratory and studied in the homes.

"The group studying electrical installations and artificial lighting combined with the group working on appliances (when) they found (they had common interests.) They devised and set up simple circuits on floor plans drawn on plywood panels. (The members of a class called) physics for home economics students (joined with this 'physical science' class) in studying electric fixtures—plugs, sockets, cords, and switches. A group from the two classes combined to make an illumination survey of the college classrooms and dormitory rooms. Their findings were presented to both classes and to the college administration. Illumination surveys were made of five homes in the community. A film . . . and pamphlets from utility corporations on illumination were discussed critically. (Data from these sources were compared with data from other sources. Interpretations from these data were compared with opinions obtained from the city's leading oculist and optometrist.)

"Evaluation took into account the method —were methods consistent with best democratic patterns? The ultimate test of the experiences was the extent to which they served the students in meeting their needs and problems. In what respects were students' attitudes toward the work of scien-

tists changed? One student summed up by saying: 'I never realized that scientists used common facts that you find all around you.'

"The question of covering of 'basic subject matter' through the experiences used has been raised by teachers accustomed to traditional subject-matter courses. In this project basic subject matter was defined in terms of student growth. That which is 'basic' is essential to the purpose. Hence the experiences used were necessarily basic or the growth would not have occurred. The evaluations indicated that the students' achievement, even in mastery of facts, was far superior to that in the course offered during previous years and in which the more usual and traditional plans of study had been followed."

The success of this project, and it was undoubtedly successful, was due to the fact that the students wanted to know and were able to learn the answers to the questions that they raised. They were not fooling, nor were they worried by the questions, "What will the teacher require of me?" "What must I learn in order to pass his examination?" Their questions were definitely personal: they wanted help in their planning for a house for themselves. The questions were at the same time social, for the young women became aware of the common interests among themselves, and of the general interest in housing throughout the community. The questions became problems because the members of this group felt personally involved in the setting out of which the questions had risen. These settings were in their present homes, their future homes within which they would be wives and mothers, and in community housing. The instructor was a competent physics teacher with some engineering experience, and he was a careful student of education as a profession, and of society. He knew young people well enough to be able to help them identify and deal with their own problems. He was held in high esteem by his students and will no doubt be remembered as a teacher who helped them with their important problem.

What were the learnings? These young women learned to meet situations with confidence, to recognize questions as problems and to find acceptable answers, and to work with others. They gained in community consciousness. They gained in understanding, and in respect for experimental methods of study. They learned many things they called "practical", because they could project the learnings into situations with which they were personally concerned.

Is this description to be accepted as a report of good education? In favor of it, it may be said that these young people did look back upon it as a rich educational experience. Did they gain in respectable scholarship? In response to this inquiry we may say, "No scholarship can be more respectable than that which helps to raise the standard of living and the level of cultural development." Our educational theory supports the conclusion that this outcome is best achieved when it is sought by most direct methods.

The work of educating the science teacher to use community resources is suggested by the qualities of personality required for successful work. The teacher will be interested in public welfare. Specifically he will be interested in better opportunities for young people, better relations among people with differing social backgrounds, better sanitary conditions as a means to reducing the incidence of illness, conditions favorable for personal freedom, and improved standard of living, and other improvements that he can see as contributing to a clearer comprehension of human needs and of the means to the realization of these needs. He will derive his aims from his interests and these will take on meaning as he projects these aims into the community within which he lives. He will seek the cooperation of others in furthering his interests. As classes come along they will bring students with the same general interests as his and set in the same

community. These interests are life-long. The teacher and his students while they are together, will cooperate in advancing their common aims and desires. These qualities of personality are not unique among people. These make up parts of the personality of all of us. As the teacher improves in his ability to work successfully toward these aims he is effectively educating himself for his work.

THE TWENTY-NINTH CONFERENCE ON THE EDUCATION OF TEACHERS IN SCIENCE

Reported for the Conference by F. L. FITZPATRICK

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THE Twenty-Ninth Conference on the Education of Teachers in Science was held on November eighth to tenth at Ball State Teachers College, Muncie, Indiana. This conference was originally convened upon invitation of the Dean of Teachers College, Columbia University, in the autumn of 1930. The first meeting was attended by representatives of teacher-education institutions in the immediate vicinity of New York City, and was devoted largely to science-teacher training problems, and to planning.

At this first meeting it was decided to hold two conferences annually; one at Teachers College, Columbia University, and another at some other institution nearby, a policy that has been followed consistently through the years. Thus, in addition to Teachers College, Columbia University; Cornell University, Harvard University, the Maryland State Teachers College (Towson), the New Jersey State Teachers College (Glassboro), the New Jersey State Teachers College (Trenton), the New York State Teachers College (Buffalo), the Pennsylvania State Teachers College (Slippery Rock), the Rhode Island College of Education, and Wilson College (District of Columbia), among others, have acted as host institutions. Through the years, however, geographical representation has been extended, and it is interesting as well as significant that in 1951, for the first time, the conference met in a Midwestern locality. Looking to the future, the Spring meeting is scheduled to take place at Teachers College, Columbia University, on May first to third, 1952.

THE THEME OF THE CONFERENCE

Dr. Robert Cooper of the Ball State Teachers College Faculty, serving as President of the Conference, was largely responsible for the very effective local arrangements for the Muncie meeting, took the lead in the development of the program, and presided at the general meetings. The theme considered by the Conference was the training of prospective and experienced teachers in the use of community resources for classroom and extra-classroom science teaching, and the relationship of the science teacher to community problems.

Following a welcome by President John R. Emens of Ball State Teachers College, this general theme was presented to the Conference by Professor S. Ralph Powers of Teachers College, Columbia University, in an address entitled *Educating the Science Teacher to Use Community Resources,* which precedes this report in this issue of *Science Education.* Six discussion groups were then formed to explore various phases of teacher training related to the general theme.

THE DISCUSSION GROUPS [1]

Group A: Study Within the Classroom of Community Science Resources. Paul Blackwood of the United States Office of Education served as Chairman of this

[1] The statements in this section are based upon

group. One phase of the discussion and report dealt with ways in which the teacher's background of community science-teaching resources could be enriched. It was generally accepted that the teacher's knowledge of this area should be acquired through experiences similar to those proposed for the teacher's students.

Among existing practices reported were the following: (1) in one school system classes are dismissed for a day, and groups of teachers devote the time to becoming acquainted with community industries; (2) in another school system, visits to industries are conducted by a technical society as a phase of in-service training for teachers; and (3) in one case a teacher produced her own motion pictures for classroom use. These motion pictures included items on the flora and fauna of the state, and on the production of two crops in the community. Similarly, another teacher employed his own lantern slides to "bring the local zoo" to his classroom.

The use of resource individuals and resource materials in the classroom was also reported by Group A. Among the resource possibilities suggested were (1) people who have special skills or knowledge relating to the topics or problems under study; (2) class representatives who go out into the community and bring back to the classroom observations, specimens, or the results of special studies; and (3) materials representative of the community, and pertinent to instruction, which can be brought into the classroom.

Group B: Making Use of Science Study Initiated in the Home or Community and Carried on in the School. The Chairman of this group was Glenn Blough of the United States Office of Education. The report of the group accepted the desirability of using the community as a teaching laboratory, and cited examples of current practices, such as (1) the development of school gardens, and the associated transfer of activities from school to home, including such specific cases as transfer of seedlings sprouted in the school to home gardens, and "farming out" of plants (or animals) among student homes during the summer months; and (2) the obtaining of trees, flowers, and shrubs for school gardens from garden clubs and conservation agencies.

Discussion in Group B was also concerned with criteria for using community resources, and the following items were suggested: (1) the community resources employed should make contribution to solution of a current problem in the school situation, and should be appropriate to the interests and maturity level of the learners; (2) an activity employed should serve to foster the development of desirable attitudes as well as to convey facts; (3) trips should be taken when they represent a "best way" to teach desirable materials and attitudes, and in all cases there should be adequate planning or preparation; and (4) resource individuals brought into the school need to know children, and to know in advance what questions they may be called upon to answer.

Group B also reported certain conclusions relating to science-teacher education, including the recommendation that college (teacher education) classes be taught in the manner in which the prospective teacher is expected to teach, and the suggestion that there seems to be need for more extensive use of community resources in such classes. The desirability of aiding the prospective elementary school teacher in the use of community resources in teaching science was singled out for mention, as was the assertion that teachers can "learn with their students," and should not reject student interests which lead them into

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written reports made by designated Reporters of the various groups, as follows:

Group A: Nan Lacy, Supervisor, Lexington, Kentucky.

Group B: D. W. Alexander, Muncie, Indiana.

Group C: Hallie Conrad, Muncie, Indiana.

Group D: Howard Michaud, Lafayette, Indiana.

Group E: Harley Mutzfeld, Battle Creek, Michigan.

Group F: Ruth Dutro, Muncie, Indiana.

realms where the teacher's knowledge may be relatively incomplete.

Group C: Extra-Classroom Study of Science in Nearby Areas. The Chairman of Group C was Edward Zetterberg of Muncie, Indiana, who was assisted by two consultants: Professor E. Laurence Palmer of Cornell University, and Herman Schneider, elementary science supervisor, New York City.

Group discussion included consideration of opportunities for extra-classroom study in the local (Muncie) situation, applications of science which are generally represented in urban areas, opportunities for instruction concerning conservation, and the general problem of developing student interest in community affairs. Recommendations were concerned with specific possibilities for extra-classroom study of science.

Group D: Science Study Through Extended Field Trips. Grace Granger of Indianapolis, Indiana, acted as Chairman of Group D. This group defined "extended" trips as those requiring more than assigned classroom or laboratory time. The group reviewed possibilities warranting such trips, including studies of air transport, conservation practices, farm practices, local geology, industry, public utilities, water supply, sewage disposal, and such institutions as an aquarium, a botanical garden, a fish hatchery, a planetarium, or a zoological park.

In the recommendations of the group, attention was directed to the need for planning, and for identifying objectives related not only to scientific understandings, but to the social implications of community life. The mechanics of planning field trips were analyzed, and it was urged that training in such planning should be provided in the pre-service and in-service of education of science teachers.

Group E: Science Study through Camping Experiences. The Chairman of Group E was Joe Craw, Superintendent of Schools, New Castle, Indiana. Discussion was focused upon the selection and use of camp areas, the advantages and disadvantages of using state parks, the financing of school camps, the objectives of instruction, and ways of evaluating the effects of camp experiences. It was recommended that in-service and pre-service education of science teachers should be designed to acquaint them with techniques of camping and out-of-door education.

Group F: The Role of the Science Teacher in Community Problems. Maxine Dunfee of Bloomington, Indiana, served as Chairman of Group F. This group identified a number of community problems having science implications and relating to civil defense, conservation, disease control, housing, nutrition, pest control, safety, sanitation, and unfounded prejudices or discrimination. Current practices in school instruction and in teacher education were reviewed. In the case of teacher education, it was urged that student participation in the solution of community problems, and participation in camp experiences, community services, and work experiences were desirable.

THE GENERAL MEETINGS

In addition to the opening address by Professor S. Ralph Powers, general meetings were devoted to reports of the study groups, visits to local industries and other places of interest, and a number of speeches and panel presentations. Among the latter was a discourse on science books by Herman Schneider, elementary science supervisor in the New York City school system. A panel on "science teaching through camping" was presented by Joe Craw, Superintendent of Schools, New Castle, Indiana, and Letha Williams, teacher from Connersville, Indiana. Similarly, a discussion and demonstration of science teaching was presented by Glenn Blough and Paul Blackwood of the United States Office of Education.

Ann Hopman, supervisor from Fort Fort Wayne, Indiana, spoke on science study initiated in the home and community and carried on in the school. Professor

E. Laurence Palmer dealt with extra-classroom study of science in nearby areas, and Lela Terrell of Huntington, Indiana, discussed science study and extended field trips. Professor W. P. Allen of Indiana State Teachers College considered the role of science teachers in community problems, and Professor Herbert Zim or the University of Illinois, spoke on the child, the scientist, and the community. Professor F. L. Fitzpatrick of Teachers College, Columbia University summarized the highlights of the conference, and discussed plans for the next meeting.

SUMMARY, AND IMPLICATIONS FOR FURTHER STUDY

Discussion groups and speakers at the Muncie meeting emphasized the use of community resources existing in local industries, utilities, resource individuals, the classroom, the home, and the natural environment, and the implications of such use in terms of teacher education. The discussions and recommendations covered a wide range of possibilities including the potential educational value of school camps and school farms.

From the discussions and from the reports it seems clear that the key to successful incorporation of community features in the materials of instruction is not simply a matter of *WHERE* a given community resource is located, or the degree of its accessibility; as a matter of fact, appropriate and accessible resources appear to be available in virtually all teaching situations. Rather, it has been strongly suggested that the basic requirement for successful utilization is *teacher sensitivity to the potentialities.* The teacher must *KNOW HOW* to utilize community resources in the first place, and the teacher must *IDENTIFY the potential resources* of his own community, and keep in touch constantly with their changing facets.

There was more than a little indication that college offerings in "basic science courses" and in courses of education need to be scrutinized in terms of their potential contribution to the teaching job, and perhaps revised and re-directed. But while many science educators agree to the foregoing conclusion, there is less unanimity of opinion concerning a concomitant issue: should proposed modification of teacher-education courses (or curricula) be primarily a matter of the content involved, or should such modification also involve methodology, in a move toward approximating, on the teacher-education level, the proposed learning experiences of the common school. Here we have an issue that appears worthy of serious consideration at future meetings.

Implicit in many statements made at the Muncie meeting was the conclusion that in science instruction student-initiated or student-teacher planned activities are comparatively few in the contemporary scene. We may affirm the virtue of exploiting student interest in instruction, but in common practice, it appears that student initiative and student planning are substantially in the background, and that teacher-directed planning and activity are dominant. Of course, there are some who defend this state of affairs on the ground that it is the normal and natural function of the teacher to direct; otherwise, they say, why have the teacher? It may be urged, however, that teacher-direction may well include the factor of student-teacher planning, and perhaps as a major feature. Here we may recognize another issue which seems worthy of further exploration.

We live in a time of cold war and troubled peace. At a recent conference in New York City, two educational leaders emphasized this fact; they were William F. Russell, President of Teachers College, Columbia University and Charles Dollard, President of the Carnegie Corporation of New York. They went on to say that the state of world affairs presented the greatest existing challenge to American education. Their action rcommendation was to effect an efficient program of citizenship education. President Russell made the point that

such a program was not a program of social studies, history, and civics alone, but a program that must be supported and implemented by all teachers. These educational leaders saw effective citizenship not only as something that was desirable in an abstract frame of reference, but as the main reliance and safeguard against the possibility that they feared most—loss of freedom by the American people.

As the founding fathers might have said, the relationship of community study to a program of citizenship education seems to be self-evident. We appear to have been on the right course in our thinking and discussions at Muncie, and in line with a growing emphasis and re-directions of American education. Science education has evident potential relationship to citizenship education. Much remains to be done before this relationship can be made a dynamic force in the American schools, but if this were not the case, there would be no challenge.

SCIENCE EDUCATION REGARDING ALCOHOL

OSCAR L. BRAUER

San Jose State College, San Jose, California

RECENTLY the teachers of a large school in Sacramento, California, were asked to select the subject most poorly taught in our school system. In a few minutes they arrived unanimously at the decision that "alcohol" was the subject most poorly taught. Other information supports this regrettable situation in California.

This summer there were 66 students in my narcotics education course. A questionnaire was submitted to the class to learn to what extent the students, themselves, had been instructed in the elementary and high schools, on the harmful effects of alcohol and other narcotics. Of those who were present on that day, 63.8 per cent indicated that they had received no instruction on these topics. Another 25.8 per cent had listened to one or two lectures as their sole instruction in the entire twelve years. Although the California State law says that the harmful effects of alcohol and other narcotics must be taught in every grade of the elementary and high school, 89.6 per cent of my students had received practically nothing that would pretend to fulfill the legal requirements of a state school law.

The situation in California is probably no worse than the condition in most of the other states of the Union. Nearly every state has a law requiring alcohol education, but these laws have no teeth. Due to a lack of interest among school officials and a lack of realization of the importance of teaching the harmful effects of alcohol the laws have been largely ignored.

However, several states are making a determined effort to teach this subject. Among these are Florida, Mississippi, and Ohio. They have directors of alcohol education who have organized the instruction in an excellent manner. More power to them!

Let's think of a teacher with 20 pupils in her class. If present conditions continue at least two of these pupils will eventually become inebriates. By inebriate we mean a person whose life has become extremely unhappy because of alcohol. A number of things may happen to him. His wife may divorce him. He may be arrested for drunkenness. He may kill somebody in an automobile accident. He may commit murder, or some other form of crime. He may die in a drunken debauch. He may become a chronic alcoholic, and spend his declining years in "Skid row", or in an insane asylum.

What is more important to such boys and girls; that you teach them a little more arithmetic, or geography, or spelling, or that you teach them to let alcohol alone? All the miserable wretches in the skid rows of cities across the country and 30 per cent of those in our insane asylums were once innocent little children, hopeful of living happy lives. Parents and teachers must realize that only a goal of total abstinence can save their children. At least one person in ten is psychologically doomed to eventually become an inebriate when once he becomes a social drinker. Moderation is impossible, as all doctors and all members of Alcoholics Anonymous agree, for the reclaimed alcoholic. It was also impossible for him before he became an alcoholic, but that he did not know. Or knowing, he disregarded the knowledge and assumed he would be the great exception.

Forty-five per cent of the alcoholics cannot be cured by any treatment. What are we doing in the line of prevention? The only thing we can do for the person who cannot be cured is to teach him total abstinence before he begins drinking. Then he will live a relatively happy life. Our whole national thinking on alcohol must be reoriented from that of reclaiming the alcoholic only, to prevention of the formation of alcoholics. Practically nothing is done in the way of prevention now. What's more, nothing of any significance can be done without a political revolution, except to educate for total abstinence. The liquor interests are spending millions of dollars to make drinking socially approved, and to prevent total abstinence. They are succeeding alarmingly well. Roger Babson says: "When America's keenest minds are using newspapers, magazines, movies, and radios to entice youth to drink whiskey, smoke more cigarettes, and make heroes of criminals, these youths should be given the other side of the argument."

Who besides the teachers will give them the other side of the argument? And if we teachers fail, then what?

According to the best estimates, 10,000 people are killed by drinking drivers each year. Ten times that many are injured and millions of dollars of damage result. Research in Sweden has revealed that the person who drinks one bottle of beer, or one glass of wine, or one shot of whiskey is a more dangerous driver than he was before drinking. Probably more damage is actually done by the moderate drinking driver than by the drunk driver. How long will our society condone such needless destruction?

According to those best in touch with the situation the price we are paying for liquor pleasure is stupendous. We are spending far more on alcoholic beverages than on education, to our disgracing shame as cultured, educated American citizens. The following quotations from persons most qualified to know, describe a startling condition.

> Some few years since, while I was serving as presiding judge of the Criminal Division of the Superior Court of Los Angeles County, I stated that the inordinate use of intoxicating liquors directly or indirectly contributed to the presence in the courtroom of *nine out of every ten criminal* cases. That statement was challenged upon that occasion. Since that time I have made a more determined inquiry and I am now more convinced than ever that that statement, made several years ago, best sums up the present situation.—Judge William R. McKay.

> Drinking in taverns is a factor in over *90 per cent of our divorce cases,* and the increase in the number of divorces is at such an alarming rate that the public must view it and treat it for what it is. . . . In a recent test I made I found that out of 21 cases, the tavern was mentioned in 20. That is not prejudice, but facts.—Judge Chester H. Christensen, Beloit, Wisconsin Municipal Court.

In Jellinek's book *Alcohol Addiction and Chronic Alcoholism* there are described eight forms of insanity that are caused only by drinking alcoholic beverages. In one of my files I have page after page of newspaper clippings about teen-age drinking parties and sex orgies. Think of the vast amount of parental sorrow represented by these incidents.

The City of Los Angeles spends

$11,000,000 yearly to collect and handle the drunks. Every other city spends a proportional amount.

In terms of human misery and suffering the cost of drinking is beyond estimate or expression. It is a sobering thought to think that total abstinence by everyone will eliminate it all. Total abstinence by half of the drinkers would reduce it 50 per cent. What a challenge to the teaching profession! In what other subject is there a chance to do so much for mankind?

THE INTERPRETATION OF SCIENCE THROUGH PRESS, SCHOOLS, AND RADIO *

WATSON DAVIS

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It is important for the people to know the true from the false, the competent from the bungler, the honest from the flimflam, and the plausible from the impossible.

We live in an age of such astonishing wonders and such plentiful conveniences—such potential destruction and such easy murder—that we are likely to forget the long and painful cultural evolution that has brought us to modern civilization with all its hopes and dangers.

Science and technology are responsible to an amazing degree for the kind of world in which we live. In one sense, too little scientific knowledge, understanding and application has given us a divided, schizophrenic world. The world's astounding advances in physics, chemistry, biology, medicine and psychology have served Nazis and Communists bent on ruthless conquest. This anti-social use of science and technology has the danger of neutralizing the multifold benefits that have come to what we believe to be the more rational, humane and civilized part of the globe. It is no ultimate gain to save a life through penicillin only to have it wiped out by atomic radiation.

Implicit in the dissemination of science and its method to all the people is the belief that if the people know the truth it will not only keep them free but allow them to act intelligently in the conduct of their social and personal lives. This may not be the whole story, if science is narrowly construed. But if the deep emotions, the hidden motivations, the biological and psychological remnants of our heredity and environment are knowable and controllable within the realm of science, then we can have some confidence that the impact of science upon humanity can mitigate the conflict and cruelty of man against man. We must believe that we can domesticate the human beast or breed out the bad genes.

Whatever is the outcome of this great and fateful chance for humanity through which we are living (perhaps every generation has lived through a crisis as epochal to it), we have the obligation to do our best to keep aloft a full-blazing torch.

If science with its applied technologies is as effective in its method, spirit and mode of thinking (the facts are fundamentally less important since they are rediscoverable) as history has demonstrated, the task of those who communicate, report, explain and teach is of greatest primacy.

The science middle man's lot is also arduous. He is neither this nor that. He doesn't belong, all too frequently. A hybrid, neither stock counts him intimately. This is less true than a generation ago, but it is difficult to be of both academy and guild.

Appreciation of science interpretation has become keener with the practice of the years. The First World War awakened the first effective realization on the part

* Paper in Symposium at meeting of the American Association for the Advancement of Science, Philadelphia, December 30, 1951.

of scientist and journalist alike that science is both important and news.

Science Service was born of that union, three decades ago. It demonstrated, by operating, by producing copy that newspapers wanted and used, and still want and use.

A statement of the purposes of Science Service, which is that of all science interpretation, is just as fitting today as it was in 1921:

"In a democracy like ours it is particularly important that people as a whole should so far as possible understand the aims and achievements of modern science, not only because of the value of such knowledge to themselves but because research directly or indirectly depends upon popular appreciation of its methods. The specialist is likewise a layman in every science except his own and he, too, needs to have new things explained to him in non-technical language. Scientific progress is so rapid and revolutionary these days that no one can keep up with it without some means of keeping in close contact with its new ideas and discoveries."

This was before radio broadcasting, before electronics, before hormones, before miracle drugs, before the vitamin era, before commercial air transport, long before atomic fission and jet engines, radar and TV. We hoped that the last war had been fought.

We have come a long way in acceptance of the idea that science should be communicated to the layman and that science is worth reporting.

In a very real sense, there is more need of taking science to the people than ever before. I am referring particularly to the method and the more fundamental facts of science, not just its easing of life, its bountiful industrial gifts and its saving of life. (I am assuming that we can somehow stop its destructive uses.)

You can always get a headline with a cure or a new weapon. You can use such reportorially golden words as cancer, atomic, sex, love, polio, death, and other emotionally rooted terms. This is a minor facet of science.

Somehow or other we have got to get over science's method and usefulness to the millions who have had no experience with the way in which science works. The man in the street does not care, not so much because he is a poet or a plodder, but because he has had no experience with science. We have not given him the chance.

It is a psychological problem as to whether all of us can use the scientific method. Some people, innately or by upbringing, do not seem to believe in cause and effect. They act accordingly. They are superstitious, illogical and credulous to the extent that they are by habit in opposition to the carefully developed and verified body of scientific knowledge. They are the victims of attractive fads and theories, old or new.

Tell them in a printed book that the earth stood still and they are willing to eclipse Galileo, Copernicus and all the astronomers since. They are the buyers of astrology. They simultaneously berate fluoridation of water to save our children's teeth and espouse a fantastic system of diet for reducing or other easy benefits. They are easy prey to anti-vivisection propaganda. They are so fed with fantasy that they would buy stock in an interplanetary rocket line if the SEC would allow it to be sold.

Most of the people are amazingly scientifically minded and straight thinking. This makes democracy work. We are confident of democracy for this reason. Our big job is to give them the background, the information and the experience of science upon which they can build their lives and the world.

The newspapers have the heavy responsibility, which in general they are fulfilling, of telling of the current progress of science so that it can be understood and applied. Science and technology constitute a field of news and feature more important basically than crime, politics, and war. It takes better writing and more knowledge to make the technical story show its throbbing

human interest. For science must be understood emotionally as well as intellectually if it is to be effective, both in public effect or in holding newspaper readers.

Newspaper publishers and editors have the responsibility of giving their readers the same kind of competent coverage of science that they give other fields of news. This means the utilization of competent national and international coverage of science news, and the providing of local coverage of health, industry and educational institutions from the science standpoint. More and more newspapers are utilizing reporters of competent technical training in their coverage of the science beat.

Aside from the need of every reader to keep up with the news of science as he does with other news fields, there is an urgent practical reason for science in the daily newspaper. Progress is so often rapid that prompt communication of new developments by the channels of scientific publication are often too slow. The newspaper becomes a link in the necessary chain of scientific information.

The busy physician may not read his professional journals weekly but he does read his daily newspaper. Often a newspaper report will bring him the first information on some new drug that he will be using in his practice. His patients alert to medical news reliably reported in newspapers may make helpful suggestions that will aid them and the practicing physician.

The industrialist who must keep up with new things to prevent his business from suffering from obsolescence, often hears of a new material or a process from the daily press.

In the rise of science understanding during the past three decades, media other than the daily press have kept pace in their treatment of science. Magazines have their science sections and articles. Books on science often sell well. And books have more staying power in the time dimension, sometimes even too much, for change and revision is an important part of science progress.

Radio, with the power of the spoken word, and television and motion pictures which add sight to sound, have paid attention to science, less so now than in radio's early years. Despite their educational potentialities, they are primarily entertainment and news media. Radio and TV have the faculty of bringing scientists with their effectiveness and limitations directly to the laymen "in person," as it were. Fortunately there has disappeared the early tendency for an actor to impersonate a scientist on the radio and present him as a conventional stereotype. I have been particularly interested in introducing to the CBS radio audience nearly a thousand scientists who say what they want to say as they want to say it in their own voices. The future of science on radio and TV is largely dependent upon what time on the available channel is left over from the increasingly strident entertainment and advertising.

All this reading about science in newspapers, magazines, and books or hearing and seeing it on radio and TV is spectator science. So, unfortunately, is much too much of our science teaching.

You must actually play science to understand it and appreciate it. It is, admittedly, more difficult to participate in science than just read about it.

It is terrifically important that many of us have actual experience in science. This can best be done during the school years. For this reason in the interpretation of science, the science clubs, largely conducted as an adjunct to the secondary schools, take on such importance.

In the science clubs many who otherwise would not have an experimental acquaintance with science have this satisfying opportunity. Over the years millions, who do not and should not become scientists and engineers, experience science as a hobby, to their personal benefit and to the enrichment of our national policy.

The science youth movement (for that is what it is) has the other important function of allowing the discovery of those boys and

girls capable of being the scientists and technologists of the future. The young person with talent often discovers himself through the excitement and satisfaction of tackling a scientific problem, experimentally.

What grass roots are to agriculture, science clubs are to science education. These bands of boys and girls are a perpetual youth movement, constantly renewed by the innate and undulled curiosity and exploratory spirit of those who are discovering through doing, the world about them.

If the future belongs to youth and to science, then there is a vastly more important place for science clubs in the scheme of things that are to be. Except that it is now given purpose, aid and encouragement through tools and programs, this ganging-up of those who want to find out about nature, machines and stuff is not a very new phenomenon.

Boys have had their workshops in barn and basement. In pioneer American days the whole struggle for existence was one big experiment and the children played their early and practical part in it. Girls, too, are no new hands at this business of experimenting, except that during certain decades getting feminine hands dirty was not fashionable. But there was always the tomboy, at that.

Today it is recognized that science education must be accelerated if our growing boys and girls are to recapitulate the scientific history of the human race in the few years between entering school and getting to or through college. The formal science classes in graded, junior high and senior high schools do their part; it is a large share, too, if the pupil is fortunate enough to have a well-informed, enthusiastic and tolerantly skeptical teacher.

The informal science clubs, squeezed in after school with the help of a teacher-sponsor, or the equivalent gang that makes models, or builds a radio set, or does chemical experiments, or collects insects, getting together in the precious free time left after school or on Saturdays and Sundays—these groups have quite as much educational value and purpose as the 9 to 3 (or whatever it is) schedules.

We used to hear a lot about leisure time activities, and I used to wonder how that sounded to these boys and girls who are always busy and never have time to do all they wish to do.

America today needs a great national quest for knowledge and understanding of the sciences. Already a million and more boys and girls in the high schools of America are eager to do things in science, and many of them are doing so now. Almost as many more adults, people who may not have had a chance to study the sciences in college, would find satisfaction, inspiration and personal development in science as an avocation.

The benefits to America and to the world that would result from an accelerated development of this science program would be most effective and gratifying.

America needs such a great quest for knowledge and science understanding. Operating in the schools it would kindle the sparks of interest and genius latent in our youth. Extending into our communities as a hobby and extended educational opportunity for adults it will bring great personal satisfaction and explain the fundamentals of American material and spiritual development.

For the future of America—for peaceful living, for industrial progress, for a successful democracy, for a strong and prepared nation—this quest for science understanding must be accomplished.

The foundations of this great movement have been built in the youth activities of Science Service's Science Clubs of America. There are more than 10,000 affiliated clubs—in every state—and almost every county, city and town of the land. A third of a million members are on the rolls of these clubs.

State science academies, colleges, teacher associations, museums, newspapers, and other organizations are cooperating. In 32 of the 48 states, there are statewide move-

ments as a part of the Science Clubs of America development. In some of the larger states there are regional organizations as well.

The National Science Talent Search for the Westinghouse Science Scholarships is now in its 11th year. This is a nationwide selection of the high school seniors who are most likely to be creative scientists of the future. The selections are made through a vigorous competition based upon results of science aptitude examinations, recommendations, evaluations and science project reports. In all, 3,000 boys and girls have been picked for honors, and the National Science Talent Search has been extended into the states through the utilization by state committees of the entries for further honors.

The Science Talent Search has pioneered the recognition by the educational and scientific world that those with talent can be picked successfully at the high school level.

The work of science clubs is culminated in science fairs and congresses held as part of the science club movement in about 40 localities. Science fairs attracting up to 1,500 entries in some cases are held annually. Newspapers and educational institutions cooperate in sending winners from these affairs to the National Science Fair. The third such event will be held in Washington next May.

The "grass-roots" of science understanding is the typical club or group in a high school in some town or big city. Science is the hobby as well as the study of each boy or girl among the 20 to 30 members. A teacher who likes science as he enjoys teaching youth, is the "sponsor." During noon hours, in class time, after school, on Saturdays, the science club members work on their projects—investigations of varying degrees of difficulty, originality and importance. The whole range of human interest and science is spanned—everything from astronomy to zoology—inventions, aids to health for the neighbors, insect collections, study of rocks, building of mechanical models, raising of animals, weather observations, food tests, chemical experiments, and thousands of other projects.

Some of these are scientists of tomorrow —and all are the citizens of tomorrow who will use and understand science.

This great structure of science for youth —primarily in our senior and junior public high schools and in our private and parochial secondary schools—has been built in the years since Pearl Harbor. (In 1941 there were only 700 clubs nationally organized; now there are 20-fold that number.) The national network of clubs has been organized and each club has been supplied *free* with basic materials for fruitful activity. This is a minimum activity, nevertheless.

Now there should be much more service to these youthful scientists. The need is greater, for we realize more keenly the importance of the facts, the utility and the philosophy of the sciences.

Of equal importance to the youth movement would be the development and stimulation of adult hobby and avocational interest in science. A certain number of the clubs in Science Clubs of America do have adult membership. Participation of adults in science activities could be developed so that numerically it would be just as large, perhaps even larger, than the participation of youth in such activities. A study made in Philadelphia some years ago showed that there were as many amateurs of adult age as there was science club members.

In understanding science, there is the necessity that the non-professional have access to the original literature. With the growing complexities of research and the multiplying numbers engaged in scientific work, the scientific literature increases almost geometrically. The scientist or technologist has difficulty in keeping up with new literature in his own specialty. At the beginning of a research career or for those who are pursuing science as a serious hobby, the task of recapitulating the scientific evolution of our organized knowledge is formidable.

Books that summarize and put in order the progress in a field and the inclusive type of review article in technical magazines serve an essential purpose. But access to the original literature is always necessary. Only the larger libraries can hope to give access to all the literature and even they must specialize. A particular library can hope to provide completeness only in selected fields. Thanks to photographic methods of copying, it is possible for any one library to service the whole world with the original literature on its shelves. Microfilm and photographic enlargements from microfilm or other photocopies are now an essential part of reference and library work. It should be possible for any researcher to have the record of the past on his laboratory desk.

The world has not yet learned to cooperate sufficiently to create one big library out of its rich and expansive literature resources, although it has the tools to do so. There is no one place to which a copying request can be sent with the assurance that the literature will be ferreted out and delivered as fast as airmail can carry it. Since dollars are being spent on elaborate literature schemes today where fractions of pennies were spent two decades ago, this does not seem to be too much to ask. The military's scientific literature activities must not hide behind the cloak of classification (in the secrecy sense) because if they serve the open and free needs of research they will build our future defenses most effectively.

In the publication of original research reports, our overburdened journals and institutions can utilize the auxiliary publication scheme pioneered by Science Service and operated by the American Documentation Institute. A single copy of the material is deposited, assigned a document number and prices for microfilm and photocopy reproduction on demand and the journal then publishes this information with title, author, etc., in order that anyone may obtain the document.

In the world utilization of scientific literature, language is often a great barrier to prompt communication. The future promises to see this problem solved practically through the use of a satisfactory international language auxiliary to the existing natural languages. There have been many attempts to make an international language but not until now has there been a careful and scientific study to produce one that can technically and emotionally serve this purpose. This linguistic invention, called Interlingua, is based on the western languages and if it is given a chance it should solve this dilemma for science and technology as well as other fields of international interchange. You can read Interlingua without any study and if it is put into use it will prove its usefulness.

The broad expanse of science interpretation, through many channels, has one common denominator. It is directed toward having the people understand science to the greatest extent possible, with an accent upon participation.

Modern understanding of science might take the form of a great experiment movement in contrast to the worship of great books. This does not mean that books are not useful. The great, historic books are important. But books are static. Science and our cultivation are dynamic. Books, like timetables, must be subject to change without notice. Faith for faith's sake must give way to the healthy and inquiring skepticism which has created so many great discoveries.

If we contemplate in too great detail the growing volume and complexity of scientific research and knowledge, we may have a feeling that the task of telling the world about it is almost impossible.

The scientist himself has the responsibility of helping the interpreter to cut through the necessary seeming mazes of blind alleys and inviting paths so that the common man can see the promised goals beyond. It is a great and endless adventure, thrilling to tell and know.

CURRENT PRACTICES IN THE USE OF GREENHOUSES AS PART OF THE BIOLOGY PROGRAM IN HIGH SCHOOLS

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Introduction

THIS study was undertaken for the purpose of ascertaining current practices in the use of greenhouses as part of the Biology Program in High School. The investigation was carried on in the name of the Science Department of the District Schools, since this department is interested in the results. The reason this problem is of interest is the fact that greenhouse work in the District Schools is not at all unified, that is, some of the schools use their greenhouses constantly in instruction while in others it is rarely used. This is due to many factors: labor problems, temperature, humidity and light controls, and the belief by many biology teachers that classwork and administrative (clerical duties, etc.,) take up so much time that greenhouse work would entail too great responsibility.

For quite some time the head of the Science Department has been concerned about problems connected with the greenhouse and how to solve them in a satisfactory manner. As a first step in getting at the core of these problems, it was decided that a questionnaire would be sent out to schools in different communities in order to find out how other schools were using their greenhouses in instruction. The questionnaire was decided upon after a review of the literature on this problem. The literature disclosed very little. No similar attempt at a survey of this kind has come to the attention of the writers. There were a few articles concerning school greenhouses. J. L. Meachum [1] wrote an article in which he tells of students at Millington High School in Michigan constructing their own greenhouse. The laying out of the building by use of the level, constructing the concrete foundation and walls, laying blocks and performing carpentry work, wiring, heating, etc.; equipment for an electric hotbed was loaned to the group by the Detroit Edison Company. After the greenhouse was constructed it was operated as a community project. That is, the school sponsored a canning program stimulated through the greenhouse project. Allerdice,[2] tells of the way in which heat and glare were reduced in the greenhouse by applying a good coat of calcimine renewed twice a year to the inside of the roof. E. L. Grove [3] discussed the advantages of the lean-to type of greenhouse for a school that could not afford a large greenhouse, but these articles were very short and did not shed much light on the current problem.

By interviews with the Head of the Science Department and Biology teachers in the District, questions which should be put into this questionnaire were decided upon. The questions were formulated and arranged under appropriate headings. The questionnaire was then drawn up and submitted to a group of biology teachers for criticism and several of the questions were re-worded. The questionnaire was then referred to other science teachers concerned with greenhouse procedures. It was agreed that the questionnaire in its then present form was adequate for its purpose.

The schools to which these questionnaires

[1] J. L. Meachum, Using A Greenhouse in Instruction, *Agricultural Education*, 18:89.

[2] G. H. Allerdice, A School Greenhouse, *School Science and Mathematics*, 30:502–4.

[3] E. L. Grove, Activities in A High School Greenhouse, *Science Education*, 29:205–6.

were sent were selected in two ways: First, the writer had access to a list of forty schools from which winners of The Seventh Annual Science Talent Search had come, and it was decided to send questionnaires to those schools. The rest of the schools (40) were picked from Patterson's Directory of Schools and Colleges in the United States, and included only those cities whose population was 25,000 or more, as it was thought that communities of this size would be more likely to have greenhouses.

Of the 80 questionnaires sent out, 49 have been returned.

TABLE I

TOTAL NUMBER OF REPLIES TO THE QUESTIONNAIRE BY STATES

State	Schools With Green-houses	Schools Without Green-houses	Total
New York	4	10	14
Missouri	1	—	1
Pennsylvania	5	8	13
Michigan	1	—	1
California	1	1	2
Illinois	3	1	4
South Dakota	1	—	1
Colorado	1	—	1
Indiana	1	—	1
Arizona	1	—	1
Virginia	—	5	5
Ohio	—	2	2
Massachusetts	—	1	1
Wisconsin	—	1	1
New Jersey	—	1	1
TOTAL	19	30	49

TEMPERATURE, HUMIDITY, AND LIGHT CONTROL

Temperature Control. Twelve of the nineteen had temperature controls of some sort and seven did not. The manufacturer of the temperature controls mentioned most was the National Thermostat Company (Minneapolis-Honeywell). This company was mentioned by three out of twelve. Others mentioned were Mercoid and Johnson Company. One mentioned gas heater controlled by thermostat; another the water-type used for chicken brooders, and still another stated that his greenhouse had one manually controlled radiator connected to the school heating system, and two capped radiators that shut off at about 80 degrees. At night when the heat is off a gas burner is set to keep the temperature as high as 65 degrees. Two did not answer this question and two said they did not know.

In the District Schools, the greenhouses are heated by radiators connected to the school heating system during the day, and at night electric heaters are used, as no school in the city has an adequate temperature control.

Humidity Control. In the matter of humidity control, only one school reported that it had one. This school is in Arizona and the control consists of water trickling over excelsior with an electric fan on one side.

Light Control. Four indicated that they had light control, fifteen indicated that they did not. None of them indicated that this control was automatic.

Divisions in Greenhouse. Only one school said their greenhouse was divided into sections with temperature controls for each section; Benjamin Franklin High School, 116th Street, Franklin Delano Roosevelt Drive, New York 29, New York, stated their greenhouse was so divided.

Labor. None of the schools indicated that a laborer or gardener is employed to assist with greenhouse management. All of the District Schools do employ gardeners to help with this work and in one school in Washington, this person has complete charge of the greenhouse, i.e. growing of plants, propagation, etc.

Educational Use-Management

Ten schools reported that their greenhouses were managed entirely by the Biology teachers. Two reported that the greenhouse was managed by the teacher of horticulture. Three by teachers and student assistants, one by the members of the Science Department, one by Agricultural classes, one by teachers and maintenance department, and one by the teacher of horticulture. It seems on the basis of these reports that most of the management is done by teachers, occasionally with student assistants. The labor problem seems to affect all of these schools, since none reported having a laborer or gardener to help with greenhouse management, the work of the greenhouse falls upon the teacher.

Fourteen schools answered that biology classes participate in the work of the greenhouse. Of the other five, one stated that due to the fact that their greenhouse was small, it was used only for propagation purposes and winter storage of some plants. One stated the principal uses the plants to decorate the school, and a few students worked in the greenhouse occasionally, but it was not used for classwork. One stated that greenhouse work was limited to a few special students. Two said that they had special classes in horticulture, and one did not indicate the nature of the special class in greenhouse work. Of the fourteen stating that biology classes participate in the work of the greenhouse the nature of classwork was indicated as follows:

1. Planting and arranging in the greenhouse.
2. Growing of plants to be used in gardens of students, study purposes for biology students, care of plants.
3. Class uses the greenhouse in the fall semester to house plants, and in the spring for growing of vegetables and flowers.
4. Greenhouse is used to illustrate methods of plant propagation. Living animals also are kept in the greenhouse for purposes of general interests of students in animal life.
5. Used for student project work.
6. Horticulture classes.
7. To illustrate lessons in biology.
8. Growing a few seeds and plants.
9. Growing of plants for gardens of about sixty pupils.
10. Since we have no real temperature control, growing of any but the most hardy plants in winter is not possible. In late February some students usually elect to plant tomato seeds started in "micro-gro" or vermiculite and later transplanted to flats or benches. All students have opportunity for this work, but only about a dozen work regularly at it.
11. Repotting of plants, use of plants in plant study, propagation of plants.
12. Experiments on phototropism, student project work in botany, observation of growth of all types of plants. Place for vivarium.
13. Study of soils, planting and transplanting.

Seven schools answered that they had special classes in greenhouse work, while twelve indicated that they did not. Two of these said that the special class was taught by the biology teachers, two by the Agricultural teachers; one by the sponsor of the garden club and greenhouse club, who is probably a biology teacher, and two by the teacher of horticulture.

Sixteen of the schools indicated that the biology department has no responsibility for gardens and lawns of the school. One stated that the biology department has the entire responsibility in this respect. Another said that the horticulture class cares for the grounds in the vicinity of the greenhouse, also the school garden and arboretum, and grow vegetables for wholesale outlet. The other stated that biology classes plant flowers and shrubs and prune the shrubs.

Financial Dealings

Four of the schools indicated that they sold products of the greenhouse. Three of these said that profits from the sales go into a fund for seeds and materials not provided. One stated that profits are turned into the business office, and there is some return in new equipment and plants, but disposal of the rest is unknown.

Six of the schools indicated that the greenhouse is financed through the Board of Education. One said that the Board of Education furnished heat, soil, and pots. The remainder stated that the greenhouse was financed as follows:

1. Laboratory fees
2. School District taxes
3. School District and donations of plants, seeds, etc.
4. Budget allowance
5. Money from student purchases of seeds; the service department keeps greenhouse in repair.
6. General allotment granted the Agricultural course.
7. School funds built greenhouse; city furnished coal.

Three did not indicate how greenhouses were financed.

Community Cooperation

Sixteen of the schools answered the question: "Do community greenhouses cooperate with the school greenhouse program?" Of this number six answered "yes" and ten replied "no". The ways in which they help are as follows:

1. Students work at commercial greenhouse under supervision of instructor and owner.

2. Instruction.
3. Invite the class to a tour of their greenhouse.
4. Advise, soil, cuttings, etc.
5. May give us plants when they have a large supply.
6. Did not indicate.

Comments Made

Many of the comments were interesting and throw further light on this study. Here are several of the comments:

"In our school the old greenhouse is nearly thirty-five years old. It has no provisions for class or lecture room, no lockers, no toilet or showers (for summer help a big asset would be showers as children love to shower when hot.)"

"The greenhouse in connection with this school is not practical because there is no water connection within the greenhouse. The only light control is by painting the glass on the outside at the convenience and discretion of the school board. The building itself faces the south instead of east where it was originally planned. Consequently the room gets terrifically hot. We have one window at the side and one at the top which must be manipulated by hand. In spite of these handicaps, the botany classes do get some practical work in handling plants and in making things grow. Personally, I think that merely getting students to appreciate handling the plants and getting their hands soiled with red earth is helpful. There has been a noticeable improvement in the attitude of most of the students toward the property of others and of the school. There is only one class in botany in the school. I hope this information may be of help to you."

"Our students may have a small space in the greenhouse or an animal cage in our animal room.

The students are very interested in their plants and animals. They are at liberty to grow anything they wish.

We have a great variety of plants and also have rabbits, hamsters, guinea pigs, rats, mice, squirrels, and a few small birds."

"I used the experience I had in combination classroom and greenhouse (curve eave) at Waterton High School, Massachusetts, in filling out this worthwhile questionnaire. We had many problems which could have been controlled very easily if the greenhouse had been constructed by an expert like Lord and Burnham who are specialists in greenhouse construction. The moisture problem was most serious because there was no partition between the greenhouse and classroom. The floor of the greenhouse was wood.

Brookline High School, Massachusetts, where I am now teaching, is planning to construct as part of a building project, a suite of biology rooms—laboratory, greenhouse, terra cotta floor in greenhouse, allowing use of hose to water with water wells under plant benches. We have specified temperature controls.

I will be most interested in the results of this survey and would appreciate hearing from you when it is complete."

"We feel our greenhouse is a great help in our biology teaching. Students of our general course take almost complete care of the greenhouse and in doing this work get a great deal of valuable information. In the study of Botany, seeds are germinated for all classes in our school. Functions of seeds, conditions for germination, stages of germination, etc., are studied in the greenhouse which is located close to all Science classes."

"Our greenhouse is about 15' x 45'. It is sunk about 6' below the level of the ground. Has one manually controlled radiator connected to the school heating system and 2 capped radiators that shut off at about 80 degrees. At night when the heat is off a gas burner is set to keep the temperature as high as 65 degrees.

We use occasional students to care for the greenhouse as part of their special projects which we call research.

As teachers we do not have enough time to do good greenhouse work and what we have is partly trial and error, and partly survival of the fittest."

"We have two 'growing rooms' at rear of biology rooms, dimensions 12' x 18' each. Both have small skylights, and windows to ceiling on two sides. Southern exposure mostly. Each has two growing benches, on wheels, 10' x 2'; a sink in each room. Window sills for flower pots are ample. Weather prevents (since we have no real control) growing of any but hardy plants through winter (i.e. geranium slips, begonias, etc.) until late February, when about 40 of my 160 students elect to plant tomato seeds, started in 'micro-gro' or 'vermiculite,' and later transplanted to flats or benches, barrels of fresh earth are brought in once a year. The tomato project and geranium slipping are very successful (they take plants home in June, and receive extra credit for them in Biology). *All* students have opportunity for this work but about a dozen work regularly at it.

Would appreciate having a copy of your summary when ready."

Conclusions

Since those schools operating greenhouses answering this questionnaire all indicated their interest in this survey, the lack of returns from the rest of the schools contacted would *seem* to indicate that they had no greenhouse.

On the basis of returns received, greenhouses seem to be limited to very few schools. Even in New York City only the newer schools operate them.

On the whole, there is very little unification in temperature, humidity, and light

controls. The only humidity control was the one reported in Phoenix, Arizona, and this, it would appear, is not a good one, because excelsior can be a breeding place of many organisms undesirable in a greenhouse. If the school cannot afford to install a recognized humidity control, it might be better to use coke or peat moss under the beds.

Some of those that did not have adequate temperature controls reported costly freezouts. It might be suggested to all schools contemplating a greenhouse that they find adequate temperature controls. The United States Plant Nutrition Laboratory, at Ithaca, New York, is glad to give helpful suggestions in this matter.

The returns indicate that management of the greenhouses is done almost entirely by the teachers, occasionally with student assistance. Since there is considerable amount of labor connected with operation of greenhouses, this is indeed a difficult and time-consuming task. Public schools in the District *do* have laborers to help with the greenhouses. In no case reported was the greenhouse managed by a laborer. Many of the schools are to be commended on the work accomplished in view of this fact.

On the basis of this survey, it may be concluded that biology classes do participate in the work of the greenhouse. In one school the greenhouse was built and is maintained by teacher and students. In only two cases was it indicated that the greenhouse was also used as a "vivarium" to house small animals of general interest to students. Greenhouses are used mostly for general study of plants and soils, and occasionally for student projects in botany or horticulture.

Community greenhouses did cooperate with schools in such matters as instruction, extending invitations for field trips to schools, giving plants to schools. The writer wonders if even more might not be glad to give assistance if asked.

In only three cases was it indicated that the biology department has any responsibility in care and upkeep of school gardens and yards, and of these only one had entire responsibility. One might conclude that on the whole, the Biology Department has no responsibility in such matters.

Only four of the schools contacted sold products of their greenhouses. The profits from the sales were put in a revolving fund for purchase of seeds and other materials used in the greenhouse. It may be concluded from this that most schools do not sell products from their greenhouses. Most schools indicated that greenhouses were financed largely through the Board of Education, and School District taxes.

It may be concluded that there is no great unification in the use of school greenhouses for instruction purposes.

Much depends on faculty interest, administration, community interest, physical set-up and the kind of controls, especially temperature controls, employed.

TIME AND PLACE OF UNDERGRADUATE TRAINING OF A GROUP OF HIGH SCHOOL CHEMISTRY TEACHERS *

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THIS is the report of a study of the academic training chemistry teachers of the white high schools, both public and private, of Alabama for the year 1948–1949 to determine when and where they had their undergraduate training. The "when" was determined by date of graduation from college. The "where" deals mainly with the kind of school—university, technical and agricultural school, teachers college or liberal arts college attended. The year 1948–1949, rather than the later one of 1949–1950, was chosen because it was the year in which chemistry was taught in those schools that teach the subject only every other year.

There was found a total of 195 chemistry teachers. The data were obtained mostly from the official college transcripts on file at the State Department of Education.[3] In a few cases the original college records were consulted.

As would be expected, most of the teachers—153, or 78 per cent—attended college in Alabama, and slightly over half of the out-of-state colleges attended were located in the three adjoining states of Mississippi, Tennessee, and Georgia. From the information available it seems that 19 had not graduated from college and there was some doubt as to whether 2 or 3 others had. The 137 who graduated from Alabama institutions were divided as to type of school as shown in Table 1. The percentages in this and the other tables are all based on a total of 195. The number of persons for whom information was found varied from one item to another, and so the total number of persons shown varies from one table to another and does not equal 195 and the total percentage does not equal 100.

TABLE 1

School Graduated from	Number of Teachers	Percentage of Total
University of Alabama....	26	13.3
Ala. Polytech. Inst........	32	16.4
State Teachers College.....	36	18.5
Liberal Arts College......	43	22.1
Totals................	137	70.3

The date of graduation, where available, was noted and Table 2 gives the number graduating by five-year periods. The biggest single year was 1948, during which 24 of the teachers graduated. About one-fourth of the teachers were less than 5 years out of college and well over one-half (58%) were less than 15 years out.

TABLE 2

Five-Year Periods	No. Teachers Graduating	Percent of Total
1944–1948.............	48	24.6
1939–1943.............	37	19.0
1934–1938.............	28	14.4
1929–1933.............	26	13.3
1924–1928.............	19	9.7
1919–1923.............	9	4.6
1914–1918.............	3	1.5
Totals............	170	87.1

In order to find out if there has been any large change in the type of college from which high-school chemistry teachers come, the group of 48 teachers who graduated during the period 1945–1948 inclusive and the group of 50 who graduated during the period 1914–1931 inclusive were tabulated. Table 3 gives these figures and shows a large increase in teacher college gradu-

* Presented before the Division of Chemical Education at the 119th meeting of the American Chemical Society, Boston, Massachusetts, April, 1951.

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[3] The authors wish to thank Dr. Morrison McCall of the Alabama State Department of Education for permission to use these records.

TABLE 3

Type of School	Number Graduating 1914–1931	Percent of Total	Number Graduating 1945–1948	Percent of Total
University	12	6.2	12	6.2
Tech. and Agricultural	8	4.1	11	5.6
Teachers College	6	3.1	19	9.7
Liberal Arts College	24	12.3	6	3.1

ates and a large decrease in liberal arts college graduates. It should be mentioned in this connection that the four Alabama state normal schools became four year teachers colleges in 1929.

Of the 192 teachers for whom the information was available, 97 were men and 95 women. Some comparisons were made as to time and place of training in order to see if there was much difference in the preparation of the men and women teachers. It was found that there were no great differences in date of graduation except during the period of World War II, when, of course, more women graduated. The most noticeable difference in the type of school was found in the graduates of liberal arts colleges, where it was found that the number of women teachers who were liberal arts college graduates was more than twice as great as the number of men. Table 4 gives these figures.

TABLE 4

Type of School	Men Teachers Graduated Number	Men Teachers Graduated Percent of Total	Women Teachers Graduated Number	Women Teachers Graduated Percent of Total
University	19	9.7	13	6.7
Technical and Agricultural	20	10.3	14	7.2
Teachers College	26	13.3	20	10.3
Liberal Arts College	16	8.2	34	17.4

CHEMISTRY FOR THE BLIND

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CURRENT concepts in the rehabilitation of the handicapped indicates that "the blind are entirely educable," and that the sentimental attitude toward them should be replaced with a philosophy according them a normal place in both school and society. After completing the splendid adaptive training in the resident blind school, they may enter public high schools or colleges and take regular courses on a parity with their seeing colleagues.

The mere fact that a visionless or visually defective student is advised against taking chemistry, may so whet his appetite that he is apt to desire the subject, especially, if he wants to be on a par with his sighted associates. The high school blind tend to be a heterogenous group from a standpoint of the extent of their handicap. Students coming from the resident blind institutions to public high school include: the congenitally blind, adventitously blind, partially blind, and those with defects in vision entitling them to residence in blind schools, although they possess some sight.

Chemistry is an integrating subject usually following physics, biology, and general science. The first few lessons in biology are necessarily devoted to chemistry fundamentals, and one unit in general science deals entirely with the introduction to chemistry. The blind high school student then,

will scarcely escape some contact with this subject.

Keen blind students may profit by the lectures and to some extent by teacher demonstration; also through tactual, auditory, and olfactory observation of chemistry setups. In actual laboratory work, little can be accomplished without constant supervision, and when it is remembered that practically all observations in chemistry are based on visual interpretation, the difficulties encountered will be appreciated. With the Taylor, Braille notation system now used in both Great Britain and the United States in mathematics, physics, and chemistry, problem solution is possible by simple adaptations.

The first lessons in chemistry deal with definitions of elements, mixtures, and compounds, and the differences between chemical and physical changes. In listing the elements in Braille, the blind might have tactual access to metals such as iron, copper, lead, aluminum, mercury, silver, gold, zinc, etc. Varying the morphology and width of these metals will prevent the blind student from learning to identify them by the individual shape of each piece of metal. The blind should necessarily be cautioned repeatedly regarding the danger of testing any substance by taste except under explicit direction from the instructor.

The crystalline or amorphous elements, such as sulphur, manganese, iodine, cobalt, and chromium may be identified similarly by taste, touch, and smell. There are a number of well-known solid compounds which the blind can recognize with their remaining senses, such as: $CaCO_3$, $FeCl_2$, NH_4Cl, $CuSO_4$, MnO_2, $FeSO_4$, $(NH_4)_2SO_4$, etc. The visionless student should learn to differentiate tactually, heavy powder from light, small crystals from large, and degrees of hardness using their fingernails. They should become proficient in detecting odors at a safe distance. They may learn to identify gases, smokes, or fumes with characteristic odors, such as sulphur dioxide, chlorine, and ammonia gas. This knowledge has some utilitrian value to the blind from a safety standpoint in the house, and possibly in their future vocational pursuits. They should be allowed to compare the weight of equal-volume bottles containing mercury, alcohol, nitric acid, water, etc., as a means of identification from the standpoint of specific gravity of liquids. Identification of acids and alkalies may be undertaken by smell, provided extraordinary care is emphasized. The blind should be warned never to touch any bottle without being told by the instructor. Also a practical laboratory exercise can be given by Braille-labeling a complete set of laboratory reagent bottles, with both chemical names and symbols or formulas. Several Braille "danger" labels should be made and glued on a strategic part of bottles containing poisonous substances, with dangerous reagents put in small, and harmless ones, in larger bottles.

The blind need to be literally scared into realizing the danger from acid and alkali burns, and the risks incident to tactile manipulation of phosphorus, potassium, sodium, etc. Wherever volatile poisons have a characteristic odor, the association of olfactory sense with the dangerous chemical may be emphasized: for example, the burnt-almond odor of hydrocyanic acid, the irritating odor of ammonia, or the fumes of nitric acid, etc.

The blind can be taught as safety precautions to detect characteristic burning odors such as sulphur, oil, gasoline, carbon disulphide, fuel, gases, benzene, alcohol, protein, and fat, etc.

When oxygen and hydrogen are demonstrated, a fair-sized, controlled, hydrogen explosion may bring home to the sight-handicapped student and seeing ones, too, for that matter—the dangers which may be encountered in the chemistry laboratory.

The preparation and properties of the gases—hydrogen, oxygen, nitrogen, and carbon dioxide, can be taught the blind with reasonable success. They may feel and name the set-up of the apparatus used. The explosion sound of hydrogen in a test tube is characteristic, and the colorless,

odorless, and tasteless properties will be appreciated if compared with NH_3 or a weak concentration of SO_2 gas.

The sight-handicapped students were given an initial project using blocks, beads, and rings to construct atom and molecule models, tactually building representative structural formulas, similar to the atom diagrams found in all modern chemistry texts.

In balancing equations geometrical figure wooden blocks or cutouts may be Braille labelled for the different elements with a number of arms representing the ions or valence. The specifications for these Bryan's valence blocks are as follows: (U. S. Patent 1938) (1) *monovalent positive* ion elements are represented by circles with one right arm. These blocks are Braille labelled with the symbols of each element and its atomic weight such as, Na, 23; K, 39; H, 1. (2) *Monovalent negative* ion elements or radicals are represented by squares with one slotted left arm, these may be Braille labelled with symbol and atomic or molecular weights as I, 127; Br, 80; Cl, 35.5; OH, 17. (3) *Divalent Positive* ion elements are represented by two pointed right armed circles, Braille labelled with chemical symbols and atomic weight, Ca, 40; Mg, 24; Ba. 137 etc. (4) *Divalent negative* ion elements or radicals are represented by two, left slotted armed squares, such as C-12; CO_3, 60; SO_4, 96; etc. (5) *Trivalent Positive* ion elements have three right pointed arms Braille labelled with symbols and atomic weight such as Al, 27; Bi, 200. *Trivalent negative* ion radicals are represented by squares with three, slotted left arms Braille labelled with molecular weight PO_4, 95; BO_3, 59. *Polyvalent positive* ion elements are represented by triangles with 2, 3, 5, pointed arms and Braille labelled with symbols valences and atomic weights e.g. Fe, 56; Cr, 52; SB+3, +5, 122, Hg+1, +2, 200. *Polyvalent* elements which may be negative or positive ions are represented by rectangles with arms carrying points for positive and slots for negative ions, e.g., N−3+3+5, 14; C+4−4, 12; S+2+6, 32; etc.

Starting with a simple chemical combination such as water to demonstrate simple replacement reactions, the H cut out circle with its one arm, will unite another atom of hydrogen to combine with the oxygen square with its two slotted arms to form H O H. The sodium atom circle cut-out with its one right arm may be connected with the chlorine atom represented as a square with one left arm, to form sodium chloride. These monovalent elements are positively and negatively ionized respectively. The calcium atom is a divalent model; to combine it with chlorine the student finds that his chlorine cut-out has only one arm, therefore two are needed to balance the calcium to complete its formula $CaCl_2$. The blind student might group his element valence blocks according to the ease with which electrons are gained or lost. The active elements such as K, Ca, Na, easily lose electrons while less active substances such as, N and Au retain them. The blind student should arrange his atomic small and large models into two groups, active or inactive, metallic or nonmetallic respectively depending upon their atomic structure. After the vision defective students have memorized some of the common atomic weights, they might work out by mental arithmetic, the molecular weights of simple compounds such as H_2O, CO_2, NaCl, KOH, and write out in Braille those requiring simple calculations such as, HNO_3, $CuSO_4$, $CaCO_3$, etc.

Simple chemical equations may be domonstrated using the valence blocks such as, $S+O_2 \rightarrow SO_2$; $H_2+Cl_2 \rightarrow 2HCl$. The more complicated double replacement equations, such as, $NaOH+HCl \rightarrow NaCl+H_2O$, $Ca(OH)_2+H_2SO_4 \rightarrow CaSO_4+2\ H_2O$, may be made by switching the blocks to the other side of the equation and linking them together.

Crystalline substances can be made especially meaningful to the blind. The tactual study of minerology and crystallography is especially interesting, if models such as the

isomeric, tetragonal, hexagonal, orthorhombic, mono and triclinic, specimens are available. Structurally crystals such as halite and pyrite may be demonstrated, using an isomeric model for comparison. A piece of gypsum may be identified with the monoclinic base, hematite with the hexagonal; topaz with the orthorhombic, and mica with the triclinic, etc. Cleavage and fracture of minerals should be taught by free tactual manipulation of representative specimens.

Mohr's classification of hardness can be made significant to the blind comparing the range of substances from the sofest, talc, to the diamond which is the hardest, having on hand for tactual observation some of these minerals, such as, talc, gypsum, calcite, fluorite, quartz, carborundum, and topaz, etc. The chemical composition of the igneous rock minerals, such as, quartz, feldspar, mica, and hornblende may be considered near the end of the course in chemistry. The sedimentary rock minerals of the coarse silicon group, such as, quartz and flint may be compared with the soft, earthy, clay-like minerals, such as kaolinite and bauxite. The carbonate rocks, calcite and dolomite, having cleavage faces with three planes, may be compared with amorphous (non-crystalline) rocks.

The carbon lessons have some utilitarian values, for the blind can comprehend the occurrence of carbon through tactual contact with coke, coal, the diamond, and graphite. Factual knowledge of some of the destructive distillation biproducts of coal, may be topics for oral reports such as, tar, dyes, coal tar antiseptics, coal, gas, hydrocarbon solvents, coke, water, gas, ammonia, etc. The carbonate rocks, marble and limestone, are also tactually accessible to the blind. They can identify petroleum products, such as lubricating oil, asphalt, gasoline, naphtha, and natural gas by smell. The blind should be able to differentiate the three kinds of coal: namely anthracite, bituminous, and peat or cannel coal by feeling, or by determining the varying degrees of hardness. The origin of coal during the carbon age is readily proved by means of fossil ferns in coal or slate, and these fossils are tactually pleasing to the blind.

Again, the terms crystalline and amorphous may be demonstrated through the diamond and graphite when tactually compared with charcoal, coke, and boneblack. Silicon carbide (SiC), or carborundum forms sharp, flat, hard crystals which can be easily identified by blind students. Carbon disulphide (CS_2), should be recognized by odor and detected in cleaning fluids and insecticides, and morever classed with the dangerous inflammable compounds, such as gasoline, chloroform, and ethers. Starch and sugar as compounds of carbon may obviously be identified by the senses of touch, taste, or smell.

The unit in chemistry entitled "Organic Compounds", dealing mostly with carbon compounds, has some value to the educated or well-read blind in that it gives them a working familiarity with many substances in common everyday use, such as, benzene, gasoline, naphtha, paraffin, alcohol, phenol, tar, acetic acid, vinegar, carbohydrates, soaps, fats, oils, glycerine, turpentine, etc. The blind student who aspires to a liberal education may derive some satisfaction from information which explains the preparation, properties, and uses of these varied domestic substances. The cleaning or detergent activity of the different kinds of soaps with their collodial properties has a significant application to blind students, in that they can feel the emulsion formed, and can then compare it with insoluble soaps formed in hard water.

Practical applications of chemistry comes in the sodium and potassium unit where compounds such as $NaCl$, $NaHCO_3$, and $KClO_3$, are identifiable by blind students. The calcium compounds particularly, $CaCO_3$ occurring in marble, limestone, chalk, calcite, shell, coral, stalactite, and stalagmite, have tactual significance for blind students. They should learn to identify the odor of unslaked lime as a safety precaution to stay away from it. The writer is

painfully aware of the significance of slaked lime, since one of his students was blinded by it on a farm when lime was used as fertilizer, and it blew back into the youngster's eyes miles away from help.

The metals—zinc, mercury, magnesium aluminum, tin, lead, silver, gold, and platinum with their compounds—will have some tactual, observational, and informative value for the blind. Models or even cut cutouts of a Braille-labelled blast furnace, a bessemer converter, jet propelled engine, etc., may be resorted to as instructional aids in place of diagrams available to the seeing students.

If the chemistry class or club visits an industrial, copper, steel, silver, pharmaceutical, chemical, food, or alcohol plants, or research chemical laboratories, surprising as it may seem, the blind apparently enjoy the visits. This is especially true when the conductor is a pleasing speaker, and the varied sounds of machinery in motion, and the clink of laboratory glassware and miscellaneous sounds are interpreted for their benefit.

The atom-smasher can be described to the blind students using their auditory sense perceptions. The electrostatic method sounds like a succession of rifle bullets hitting a target, while the cyclotron sprays atomic bullets like beaded shot from a shot gun. The atomic bullets bombard the uranium placed on the bottom of the atom smasher with 50,000 volts causing bolts of lighting which split the atom, liberating deadly radiation. The sounds involved can be made very meaningful to the blind.

Television or movies depicting educational industrial or chemistry laboratory techniques are surprisingly interesting to the blind, if a seeing student acts as interpreter and describes the action of the film as an adjunct to the regular sound and musical interpretation. Films shown the blind include, the halogens, nuclear synthesis, atomic energy, sulfuric acid plant, and the history of chemistry, etc.

CONCLUSION

Some phases of chemistry may be taught the sight handicapped pupil if simple, tactual, and auditory devices are set up for them. There are very few aims and objectives which can be considered desirable outcomes of chemistry for the blind aside from (1) general interest, (2) knowledge of household or domestic chemicals, in common daily use, and (3) hobbies (mineral—rock collections).

Chemistry tends to be a popular semivocational or avocational subject in boys' high schools, and also has some utilitarian domestic science applications in girls' high schools also. Should blind students desire to tackle general inorganic chemistry in spite of their handicaps, the writer believes they can benefit by the attempt, if care is used in presentation. Widely diverse cultural and scientific interests cultivated in the intelligent blind help to motivate satisfactory adjustments in their circumscribed sphere of existence. "And the Lord said, Let there be light and there was Light."

A COMPARISON OF TWO METHODS OF TEACHING MECHANICS IN HIGH SCHOOL *

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THE PROBLEM

THE presentation of subject matter is the means through which the students understand and interpret related concepts. To a large extent the success with which they do this depends upon the method of instruction employed. Educators have emphasized the fact that one of the major problems of the school is the adaptation of teaching materials to the learner. For success with students of different abilities not only must the subject matter itself differ but its treatment as well. The teaching of Physics has not been too successful according to Bail [1] and others. There were many reasons for this. While the content and applications of the Physics course have slowly changed, the method of teaching this subject has remained much the same in spite of the different type of student studying Physics today. Youth needs more science in order to adjust to a world that is becoming increasingly complex. If the student does not have the mental ability and academic interest to benefit from our science instruction, it will be necessary to change both the content and methodology of the high school science courses so that all students will be interested in the work and can study science successfully.

The Problem and Its Scope

This investigation was undertaken to ascertain the degree to which the students obtained and then retained a knowledge of certain important Elementary Mechanics concepts through two methods of teaching. The Control Method consisted of a combination of the recitation, demonstration, laboratory, film, and supervised study methods. The Experimental Method consisted of a discussion of pictorial ideographs only. These were graphic representations of a familiar event, object or idea used to make a concept clear to the students by means of the visual sense. They took the form of a picture, photograph, cartoon, chart or diagram.

The study considered only the teaching of facts and generalizations of Mechanics and was not concerned with any other objectives of science education. Specifically, it sought to determine whether there were significant differences in the gain in knowledge of Mechanics by the students subjected to both methods of instruction. An attempt was also made to ascertain which type of student, bright or dull, good reader or poor reader, benefited more from each method.

THE PROCEDURE

The Experimental Sample

The experiment was conducted in a large city high school in a district where racial and religious tensions, poor cultural background and the low economic status of the school neighborhood produced a general lack of interest in school work. Only one third of the students who participated in this study were pursuing an Academic Course. A questionnaire disclosed that bilingualism existed in practically all homes with the exception of those of the Negro and Irish students. Only six of the one hundred forty-one subjects were girls. During the time of this study, 55 per cent of the students studying Mechanics were employed after school on a part time basis.

Other information regarding the subjects was obtained through standardized tests, school records and interviews with

* Based on a doctoral dissertation in the School of Education, New York University, 1950.

[1] Bail, Philip, A Critical Analysis of Pupil Responses to the Concepts of Mechanics in High School Physics. *Science Education*, October 1933, 17:226–233; December 1933, 17:321–329.

the students. The mean I.Q. of the sample on the Otis Test [2] was 100.1. The range of intelligence was from 78 to 130. As a group the students studying Mechanics were moderately poor readers. The scores on the Nelson-Denny Test [3] compared with the norm for the progress grade showed a range of reading ability from an acceleration of 4.6 years to a retardation of 5.4 years. The subjects ranged from the second to the eighth term. The mean progress grade was the fifth term or the beginning of the junior year. The average age of the students at the beginning of the course in Mechanics was 16.7 years. The youngest was 15 years of age while the oldest was 16 years and 9 months.

The students were put into Mechanics classes without any attempt at ability or course grouping. As an elective subject it was open to all students after the completion of a year of General Science. Since the students in the Mechanics classes were selected at random the classes were believed to be composed of students of similar age, intelligence, interests and science background. There were two classes in Mechanics each term. It was therefore necessary to carry on the experiment for two successive terms to obtain a more statistically satisfactory number of cases.

Instruction of the Groups

The course in Mechanics was divided into three units of work in such a way that there was very little, if any, overlapping of subject matter. This made the use of the rotation scheme possible. For the first unit of work one class each term was designated as the Control Group while the other class made up the Experimental Group. For the second unit of the course of study the designation of the groups was reversed. For the third unit of instruction the classes changed back to their original designation.

The groups differed only in the classroom teaching procedure. The constancy of additional factors or safeguards was maintained after the manner of Knox.[4] A single course of study, the concepts and applications, the time allotment for each topic, the textbook used and the homework assignments for both groups were the same. All the students were required to keep a notebook in which were kept the homework assignments as well as class notes. No attempt was made to give either group of students any formal class notes.

The Methods of Instruction Compared

The Control Group received the combination method of instruction of Nash and Philips [5] in which the different topics were taught by means of such standard classroom procedures as the recitation, demonstration, film, supervised study, and laboratory exercise. For each lesson the method employed was the one which the instructor and the members of his department believed would give the best results for the topic in the light of the type of student being taught and the facilities and materials which were available.

The Experimental Group was taught the same concepts and applications by means of a discussion of pictorial ideographs which were projected as lantern slides as suggested by Evans and Dennis [6] and Motovich.[7] No experiments, classroom films, demonstrations, or laboratory materials of any kind were either seen or utilized by

[2] Otis, Arthur S., *The Otis Self-Administering Test of Mental Ability, Higher Examination, Form D.* Yonkers, N. Y.: World Book Co., 1928.

[3] Nelson, M. J. and Dennis, E. C., *The Nelson-Denny Reading Test for College and Senior High School, Form A.* Boston: Houghton Mifflin Co.

[4] Knox, W. W., The Demonstration Method Versus the Laboratory Method of Instruction with the Individual Demonstration in Elementary College Biology. *Science Review,* May 1927, 25:376–386.

[5] Nash, H. B. and Philips, M. J. W., A Study of the Relative Value of Three Methods of Teaching High School Chemistry. *Journal of Educational Research,* May 1927, 15:371–379.

[6] Evans, E. Ben and Dennis, Albert, Teaching the Use of the Library with Lantern Slides. *Library Journal,* January 1941, 66:75.

[7] Motovich, Esau, Safety Education in Hand Made Lantern Slides. *Educational Screen,* February 1940, 19:62–63.

this group. By the means of several simple thought questions by the instructor the students' attention was focused upon certain elements and relationships in the lantern slides which were then discussed by the students in the light of their past experience and interests.

Widespread classroom participation among the students was encouraged by allowing a full and candid expression of their opinions. The teacher volunteered information only when necessary. The tempo of the lessons afforded the students sufficient time to study and discuss each lantern slide. When the instructor felt that a concept was fully understood the next slide was introduced. The rate of presentation of the material was therefore geared to the students' interest and their ability to learn the material. A brief log of each lesson was kept by the teacher.

To illustrate the difference in the two methods used in this experiment a lesson on kinetic energy may be used. In the Control Class an iron ball held at different heights was allowed to fall on a piece of balsa wood and the damage in each case was noted. Iron balls of different weights were then dropped from the same height on another piece of balsa wood and the damage was again noted. From these demonstrations the students concluded that the factors influencing the amount of kinetic energy which an object possesses are its weight and its velocity and that the latter is of greater importance than the former.

The same lesson on kinetic energy was taught in the Experimental Class in the following fashion. A lantern slide showing a collision between a truck and a passenger car was projected. The truck is shown coming off second best. The discussion brought out the fact that the passenger car should have sustained greater damage since it was lighter. A possible explanation was the fact that the truck was standing still when it was hit. Evidently another factor besides weight had to be considered. Questioning elicited the fact that the velocity affected kinetic energy. A student recalled knocking over a heavier adult while running very fast. Evidently the velocity is more important than the weight of an object in determining kinetic energy. The next slide showed four football backfield men, the weight of each and the time in which each could run one hundred yards. This slide served to center the discussion about how much kinetic energy each man possessed when running full speed and therefore which player was best suited to carry the ball through the line in order to gain the necessary yardage for a touchdown.

The Course of Study

The course in Mechanics was a modification of the pre-induction training course entitled, "Fundamental of Machines",[8] jointly prepared by the War Department and the United States Office of Information. The course was organized around a series of major concepts in Mechanics designed to give training in scientific thinking and to impart knowledge which would be of use to the students upon their induction into the armed forces. To allow sufficient time for testing and to be certain of completing the main work of the course, a short unit dealing with metric and other measurements was eliminated from the original pre-induction course.

To these concepts were added Bail's list.[9] The combined list of concepts was sent to five selected high school Physics teachers. These judges were asked to check the concepts which they believed were important enough to be included in a course in Mechanics and to suggest others that had not been listed.

The final list of concepts was organized into three units of work.

Unit I—Matter, Energy, Work, etc.
Unit II—Simple Machines
Unit III—Force and Motion

[8] United States Office of Education. *Fundamentals of Machines PIT 101.* Washington, D. C., Government Printing Office. 1943.

[9] Bail, op. cit., page 1.

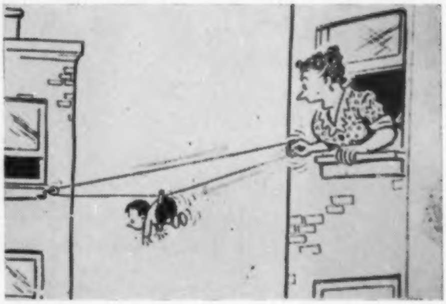
The Pictorial Ideographs

The pictorial ideographs which were based upon each concept were reproductions of actual objects and events made into miniature lantern slides. These were obtained from newspaper, pamphlet and magazine advertisements, pictures and cartoons. Illustrations that made use of homely analogy and which could tell a story without captions or titles were taken from such popular Physics textbooks as those by Lemon [10] and Stephenson.[11] Where it was not possible to obtain an ideograph from these sources the idea was planned, drawn, and lantern slides were made. Plate I consists of contact prints of eight representative ideographs and the concept each illustrated. A total of five hundred lantern slides were used for the entire course of study.

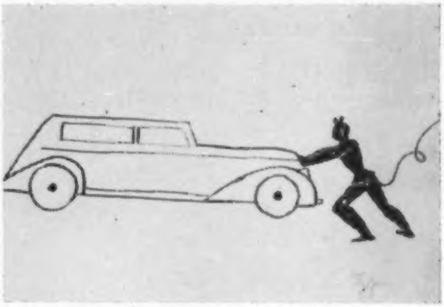
As can be seen from these contact prints the ideographs dealt with common things, interests, activities and experiences in the lives of the students. Sports, the home, the war, news, comics and romantic subjects in which concepts of Mechanics were illustrated made up the subject matter of the lantern slides. The criteria for the construction and selection of the pictorial ideographs were those set forth by Coles [12] and Dent.[13]

The Achievement Tests

Since no standardized achievement tests for the course of study were available mimeographed tests of the proper scope were constructed. Objective type multiple choice questions for each concept were made, in keeping with McCall's [14] criteria



A single fixed pulley may be used to change the direction of a force.



Friction reduces the efficiency of a machine.

No work.

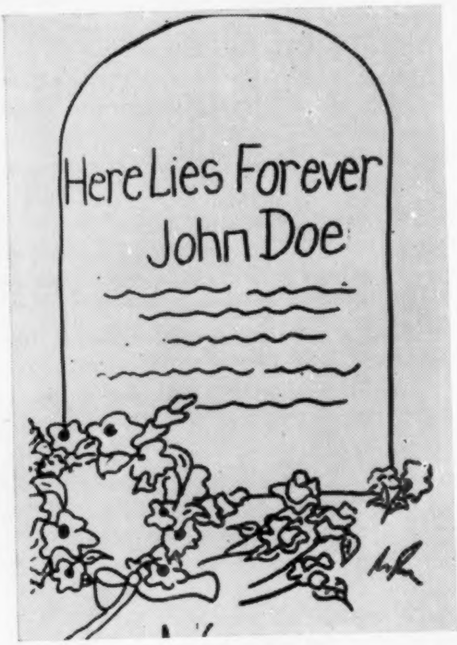
[10] Lemon, Harvey Brace, *From Galileo to Cosmic Rays.* Chicago: University of Chicago Press, 1934. Pp. XVIII+450.

[11] Stephenson, Reginald Joseph, *Exploring in Physics.* Chicago: University of Chicago Press, 1935. Pp. XIV+204.

[12] Coles, Victor, Visual Aids in the Language Arts Program. *Elementary English Review.* November 1944. 21:256–261.

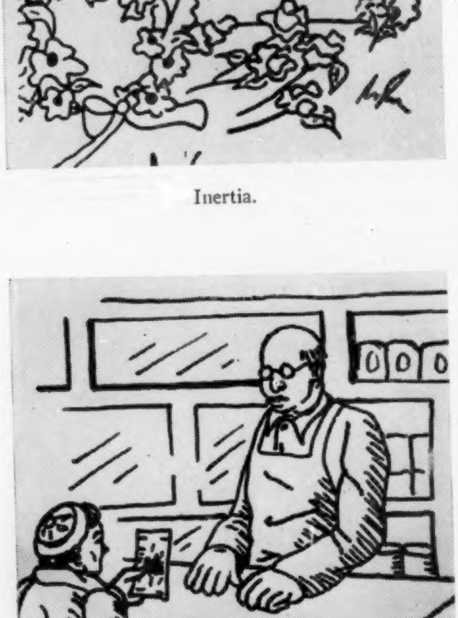
[13] Dent, Ellsworth C., *Audio Visual Handbook.* Chicago: Society for Visual Education, 1946.

[14] McCall, William A., *Measurement.* New York: Macmillan Co., 1939. Pp. XV+535.

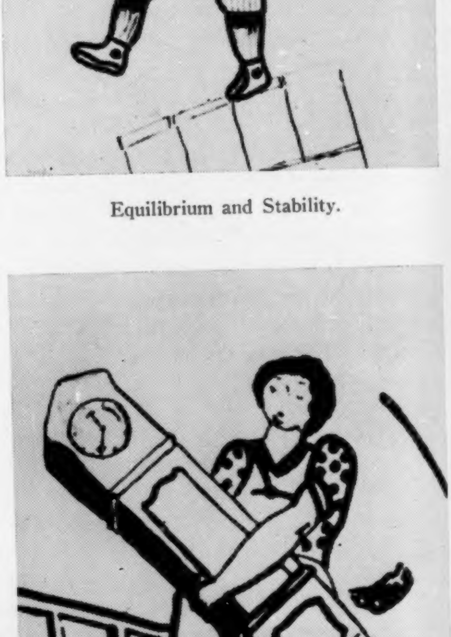


Inertia.

Equilibrium and Stability.



Input work equals output work (no friction).



Center of gravity.

Friction causes wear.

for test construction. Test validity was assured by having the questions which could be scored objectively parallel the course of study. The questions were similar to those commonly found in published tests and New York State Regents Examinations. They were designed primarily to test knowledge and understanding, but included questions which measured other aspects of thinking. Whenever possible the illustrations used in the test were different from those used in class. The questions were submitted to the same judges who rated the concepts.

A preliminary screening test of one hundred-fifty questions was given to five Mechanics classes at the conclusion of each unit of work. These students were all taught by the Control Method before the experiment proper was begun. A common method of obtaining test reliability is by a determination of the critical ratios. Only those questions in which a critical ratio of 1.7 or higher was obtained were included in the final tests. This may be interpreted to mean that the chances are 95 in 100 that the same test given to the same students at another time would yield similar results. The final unit tests were limited to eighty questions each and ranked in the order of difficulty.

Measurement of Gain and Retention

The same tests were given to the students in both the Experimental and Control Classes before and immediately after they had studied each unit. The difference between the scores on the pretest and the post-test was considered the immediate gain in information. The same unit test was administered two months after the work of Units I and II had been completed to measure delayed recall. The amount of information retained, or the recall gain, was the difference between the scores on the recall test and the original pretest. Since the experiment was carried on for two terms with the intervention of the summer vacation it was necessary to measure the delayed recall for Unit III after an interval of three months.

THE FINDINGS

Method of Collecting the Data

The means of the scores on the pretest, post-test and recall test together with the resulting immediate and recall gains were first computed. There were few extreme scores which might have exerted an undue influence upon this measure. The standard deviation was next obtained to compare the homogeneity of both groups and to find the critical ratio. Peters and Van Voorhis[15] consider a critical ratio of 1.7 as sufficiently significant for one to safely draw a generalization. This signifies that in 95 chances in 100 the difference is due to factors other than chance, which in this case would be the teaching method. The chances were obtained from Garrett.[16]

[15] Peters, Charles C. and Van Voorhis, Walter R., *Statistical Procedures and Their Mathematical Bases. First Edition.* New York: McGraw-Hill. 1940. Pp. XIII+516.

[16] Garrett, Henry Edward, *Statistics in Psychology and Education. Third Edition.* New York: Longmans Green. 1947. Pp. 465.

TABLE I

SUMMARY OF SIGNIFICANT MEAN PERCENTAGE DIFFERENCES, CRITICAL RATIOS AND CHANCES FOR THE TEST SCORES AND GAINS FOR ALL GROUPS OF STUDENTS FOR THE COURSE OF STUDY

		Entire Groups			Good Readers			Poor Readers			High I.Q.			Low I.Q.		
Unit	Test and Gain	Sig. Diff. in %	C.R.	Chances in 100	Sig. Diff. in %	C.R.	Chances in 100	Sig. Diff. in %	C.R.	Chances in 100	Sig. Diff. in %	C.R.	Chances in 100	Sig. Diff. in %	C.R.	Chances in 100
I	Pretest Post-Test	+ 6.5	+2.0	98				+10.0	+2.0	98				+14.6	+2.8	100
	Immed. Gain	+12.4	+2.14	98				+20.6	+2.35	99				+24.7	+2.5	100
	Recall Test	+ 9.8	+2.45	100	+ 7.0	+1.8	96	+10.8	+1.8	96				+13.7	+2.3	99
	Recall Gain	+20.0	+3.0	100	+15.1	+1.9	97	+21.8	+2.0	98				+24.8	+2.66	100
II	Pretest Post-Test	−11.7	−1.9	97				−20.0	−2.24	99				−27.7	−3.0	100
	Immed. Gain													+21.3	+2.0	98
	Recall Test															
	Recall Gain							+19.0	+1.74	96				+27.0	+2.3	99
III	Pretest Post-Test							+11.3	+1.7	95				+10.7	+1.7	95
	Immed. Gain							+21.3	+2.05	98				+20.0	+1.7	95
	Recall Test	+ 9.1	+1.7	95				+17.0	+2.0	98				+17.0	+2.2	99
	Recall Gain	+30.4	+2.6	100				+35.0	+2.2	99				+37.0	+2.3	99

The data were further explored to see which students made relatively good progress with the two methods of instruction. The groups were divided into sub-groups of approximately equal numbers of poor and good readers and students with high and low I.Q. A sub-group using one method of instruction was compared with a similar type of student in the other group using the other method by the same statistical procedure outlined above.

A summary of the results obtained from the data for the two methods of instruction for the entire Control and Experimental Groups; for the good and poor readers and for the high and low I.Q. students in each group may be found in Table I. Only the significant differences in test scores and both immediate and recall gains in percent relative to the unit test for these groups of students are included. They are expressed as positive (+) when in favor of the Experimental Group and negative (−) when in favor of the Control Group.

An Analysis of the Significant Differences

For the entire Control and Experimental Groups significantly better learning occurred with the latter group in Unit I. Although the mean pretest scores were similar for both groups the mean post-test difference was +6.5 per cent. The critical ratio when calculated was +2.0 which represented 98 chances in 100 that this difference was a significant one. The mean gain in information was +12.4 per cent. This was also a real mean gain in 98 chances in 100 since the obtained critical ratio was +2.14. The mean difference on the recall test was +9.8 per cent. This means a significant difference in 100 chances in 100, since the obtained critical ratio was +2.45. With regard to the mean recall gains after an interval of two months an additional mean recall gain of +20.0 per cent can be seen. Again the chances are 100 in 100, that this was a real difference since the critical ratio which resulted was +3.0.

The Control Group had a distinct significant advantage at the beginning of the work of Unit II. There was a mean difference of −11.7 per cent on the pretest. The critical ratio was −1.9 which signified in 100 chances in 100 that the difference may not be attributed to chance. Yet, on the post-test and on the recall test there was no reliable difference between the results of both groups. It might therefore be said that the Experimental Group had learned the work of this unit and could recall the information learned two months later by 11.7 per cent, since this was the extent of the advantage which the Control Group had before this unit of work had been studied.

In Unit III learning by both groups was the same. This was true both as to the mean pretest and post-test scores and for the immediate gain in information. However, there was a real mean superiority of +9.1 per cent on the recall test. The calculated critical ratio was 1.7. This means that the chances are 95 in 100 that the difference may be ascribed to the Experimental Method. There was also a real mean difference of +30.4 per cent in 100 chances in 100 for the delayed recall of the information of this unit of work three months after it had been studied. The critical ratio was +2.6.

The more intelligent students of both groups learned and recalled the information of the entire course of study equally well under either method of instruction. A significant difference between the test scores and gains is nowhere apparent. The same may be said for the good readers in the Control and Experimental Groups except in the case of the recall test and the recall gain of Unit I. The mean difference on the recall test was +7.0 per cent. On the recall gain a mean superiority of +15.1 per cent was apparent.

In Unit I, the poor readers of both groups did equally well on the pretest. A mean difference of +10.0 per cent is noted when the post-test scores were compared. The mean gain in information which resulted showed a decided superiority of +20.6 per

cent in favor of the Experimental Group. On the recall test there was a mean difference of +10.8. This produced a mean difference of +21.8 per cent for the recall gain.

There was a real mean advantage of —20.0 per cent on the pretest in Unit II. For the mean immediate gain the Experimental Group had drawn even with the other wiping out the initial superiority of the latter. A mean difference of +19.0 is to be noted for the recall gain.

Neither group was superior at the start of Unit III. There was however, a mean post-test difference of +11.3 per cent. The mean gain which resulted was +21.3 per cent. The mean difference on the recall test was +17.0 per cent. The recall gains again showed a real difference by the same group of +35.0 per cent.

The low I.Q. students of both groups had a similar initial knowledge of the work of Unit I. On the progress test there was a mean superiority of +14.6 per cent. The immediate gains again showed the same group to be statistically superior to the extent of +24.7 per cent. For the immediate gain a mean difference of +13.7 per cent was apparent. The same group was reliably superior to the extent of +24.8 per cent for the recall gain.

In Unit II there was a mean difference on the pretest of —27.7 per cent by the Control Group before the work of the unit had been studied. Not only did the Experimental Group cut down this initial advantage but built up an additional mean gain of +21.3 per cent. The same group recalled more of the information it had learned two months before since there was a mean difference in the recall gain of +27.0 per cent. Both groups again started out evenly in Unit III. There was no significant difference in the means of the pretest. But the mean post-test difference was +10.7. The mean gain shows a significant difference of +20.0 per cent. The recall test also revealed a mean difference of +17.0 per cent. This produced a mean recall gain of +37.0 per cent.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1—All the significant gains for all types of students and in all three units of work were made by the Experimental Group. At no time during this study with any type of student and in any unit of work of the course of study was a reliable gain either immediate or delayed made under the Control Method in which a combination of accepted methods of teaching science were used. The frequency with which the gains occurred and the size of the gains, especially with the poor readers and slower learners, where there was significantly better learning of as much as +24.7 per cent and the ability to recall the information learned by +37.0 per cent, are an indication of the superiority of the Experimental over the Control Method of instruction.

2—The data indicate that for both methods of instruction there was not an appreciable loss of information during the two months following the completion of the work of Units I and II. A much greater loss in information was noted three months after the work of Unit III had been studied. This suggests that during the third month after studying a unit of work forgetting is appreciably accelerated.

A Discussion of the Findings

If the present investigation could have been continued for a longer period of time groups of larger size could have been tested and hence more valid results could have been obtained. It may also be true that unconscious bias may enter when the same instructor teaches the Experimental and Control Groups of students. This danger may be the lesser of two evils since it eliminated the necessity of equating instruction and made more certain that the same information was taught to both groups. Any conclusions which are presented must apply specifically to the course taught in this study. Similar conclusions may not be drawn as to the comparative effectiveness of this instructional method

for any other science course at any other school although the nature of the experiment is such that it is strongly indicative for other courses and schools.

No one method of instruction is superior for all topics and for all students. In a short term investigation lasting but a single school year and with a limited number of students it might be difficult to show a marked superiority of one method of instruction over another. Within the framework of this study the data offer experimental evidence that pictorial media aid materially in the learning process both for immediate and delayed recall. The method of teaching Mechanics to slow learners and poor readers by means of a discussion of pictorial ideographs is as effective as a combination of accepted methods as measured by the tests here used.

The essence of science teaching has been the demonstration and the laboratory exercise to discover truth. More recently, lantern slides and motion picture films have become popular for isolated lessons where it was felt that the demonstration and laboratory exercise were inadequate. The result has been the widespread use in science teaching of a procedure in which for each lesson the method employed was the one which the teacher felt would achieve the best results. In the Experimental Method the students were given insight into the concepts of Mechanics through a discussion of pictures which dealt with their everyday experiences. No science equipment of special supplies save projector and slides were used.

Science teachers particularly have felt the ever increasing lack of what once were considered to be the essential supplies and equipment necessary in teaching their subject. It may be difficult for science teachers steeped as they are in the laboratory and demonstration methods of instruction to accept a way of teaching science without the use of a single piece of science material save slides. All too many school programs are influenced by tradition. However, the fact is clear that the students engaged in this investigation not only learned more in each unit of work through the Experimental Method, but also remembered what they had learned better. This was especially true for the students of limited mental ability and the poor readers for whom special methods of instruction are so badly needed and so widely sought.

It might be well to consider benefits other than the efficiency of learning that might accrue to the students from the use of the Experimental Method of instruction. A log book in which impressions were entered after many of the lessons discloses comments on matters not properly within the scope of the study. While the students were not directly asked their preference with respect to the methods of instruction, the comment overheard by as well as those directed to the teacher made it plain that the students preferred the Experimental Method. The informality and the wide range of subjects discussed appealed to the non-academic students who were interested in knowing about the things and events around them and thus had more to say in contributing to the pool of facts and experiences. There were fewer disciplinary problems and the records of the class showed that fewer students failed to do homework, ordinarily a serious problem. The teacher found the Experimental Method of teaching more stimulating because of the wealth of experiences evoked. The discussion of the slides also gave deeper insight into the problems and needs of the students.

The log disclosed that certain lessons when the Experimental Method was used produced high interest and eager pupil participation. The lessons dealing with kinetic energy, the conservation of energy, friction and efficiency, stability, equilibrium and Newton's Laws of Motion are examples. If the claim is made that these topics are inherently more interesting, an answer would be that such interest was not shown by the students studying under the Control Method. The suggestion is therefore offered that the excellence of these lessons were primarily due to the pictures

which recalled for the students interesting life experiences. On the other hand a few lessons were not enthusiastically received. In these lessons there was a paucity of picture material. Given better pictures on more interesting subjects to discuss, even better experimental results might have been obtained.

Not only did the students discussing pictures learn certain concepts inherent to the course of study but they did so in less time. The log contained several notations pointing out that as many as fifteen minutes of certain lessons might have been saved without loss in learning.

Recommendations

Several problems which arise as a result of this study are concerned with a further improvement in the basic techniques of the experiment. If pictures are valuable in learning, the science teacher must know how best to use them. Further research utilizing the method of investigation employed in this study should be initiated with other science courses, on other levels and with all types of students. Although the present study dealt with gain in information, additional light might be shed in the future on the other major goals of science when more precise means of measuring these outcomes are available. Since several lessons appeared to be very highly successful it might be well to investigate which topics are particularly adaptable to pictorial presentation.

The rate of forgetting also should be a subject for consideration. Does the retention of science information follow the Ebbinghaus form of curve or does retention increase with time? In an attempt to find those who might learn best pictorially, students who are eyeminded, as determined by tests for visual acuities such as eye fixations, might be compared with those students who are poor visualizers. Still another whole line of inquiry might concern itself with the cost of science education. This is especially important where there is a minimum of laboratory equipment and a limited appropriation for supplies. Equally important is the matter of teaching science effectively from the viewpoint of economy of time.

There is reason to believe that reading and vocabulary might be improved through a discussion of pictorial ideographs. Mac Lester [17] found that pictures helped students who were handicapped with a poor vocabulary. Poor readers have been found to have faulty or no mental pictures, unlike the better readers who visualize while reading. The use of visual methods in which the picture was basic has greatly accelerated the learning process in the training program in the last war.

Additional studies, all perhaps restricted in range, taking the technique developed here as a starting point and building refinements upon it are indicated for the classroom teacher. Teaching can be done more easily or more effectively with one instrument than with another and some students are reached more readily through one medium than through another. Each contribution, no matter how small, helps build up a backlog of knowledge that promises to raise teaching to the level of a science through which students obtain the maximum value from the time which they spend in school.

[17] Mac Lester, Amelia, The Use of Pictures in Teaching. *Virginia Journal of Education*. April 1942. 35:313–314.

THE DEVELOPMENT OF SCIENCE EDUCATION IN THE JUNIOR HIGH SCHOOL

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I. Historical Background in the Teaching of Science.

MODERN education and modern practices in education may be considered as originating in the revival of thinking during the Renaissance period in Europe. As Wilds brings out in his discussion of modern educational theories:

> The foundations upon which the various modern theories of education have been built were established in ancient and medieval times; but it took certain definite social, political, economic, and cultural changes that occurred in western Europe during the fourteenth and fifteenth centuries and thereafter to modify these foundational elements and crystallize them into the educational theories that have been prevalent in recent times.[1]

The intellectual curiosity of this period produced several outstanding scholars who were willing to turn from the narrow scholasticism of the medieval period to the broader area of natural phenomena. Roger Bacon, in the thirteenth century, and Leonardo da Vinci, in the fourteenth century, pointed the way in probing and experimenting in scientific areas. Yet, modern science may be said to have had its real origins during the sixteenth century in the brilliant work of Copernicus (1473–1543), the great Polish astronomer, Galileo (1564–1642), the well-known Italian physicist and astronomer, Kepler (1571–1630), the highly-respected German astronomer and mathematician, and Newton (1642–1727), the outstanding British scientist, mathematician, and philosopher. In fact, it is generally conceded that Newton's *Principia*, published in 1687, was the basis for all modern investigations in the physical sciences. The following passage from Wilds emphasizes this new school of thought in educational thinking:

> What the philosophy of Aristotle was to the ancient world, what the theology of Aquinas was to the medieval world, the science of Newton has been to the modern world. These experimental scientists do not figure directly in the history of educational thought, yet the spirit back of their work was the spirit that infused the realists and determined, even though indirectly, the destiny of all later education.[2]

This period of realistic thinking in education found its greatest expression in the ideas of the sense realists. Instead of a verbal realism found in books, or a social realism experienced in human relationships, the sense realists promulgated the reality found in the laws and forces of nature. This development may be called scientific realism and represents the beginning of the scientific movement in education.

Two great educational thinkers emerged in this period of scientific realism to leave their influence on the development of science in education. The famous English statesman, philosopher, and scientist, Francis Bacon (1561–1626), suggested the use of the inductive method in teaching in his authoritative book, *Novum Organon*, published in 1620. As Brubacher states in his discussion of methods of instruction:

> What was new in this book [*Novum Organon*] as compared with the *Organon* of Aristotle was the emphasis that Bacon placed on inductive rather than deductive logic. He stressed the collection of data through sense observation and the conclusion by induction therefrom as to the exact nature of reality and the world in which we live.[3]

Bacon had a profound influence on the thinking of John Amos Comenius (1592–1670), a Moravian bishop, philosopher, and educator. Comenius first actually used the

[1] E. H. Wilds, *The Foundations of Modern Education*, New York: Rhinehart and Company, Inc., 1942, p. 249.

[2] *Ibid.*, p. 315.

[3] J. S. Brubacher, *A History of the Problems of Education*, New York: McGraw-Hill Book Company, Inc., 1947, p. 204.

inductive method in teaching, and insisted on the use of objective reality in his work. If the objects themselves could not be used, he suggested pictures and models. His famous textbook for children, *Orbis Pictus,* made the first use of illustrations to accompany the text. In this study, which is concerned with vitalizing the teaching of science through extensive utilization of audio-visual materials, it is fitting that tribute be paid to the thinking of Comenius over 300 years ago. For it is in his teaching that we find the first systematic use made of non-verbal teaching materials. His words carry a prophetic meaning for modern educators:

> They will learn, not for the school, but for life, so that youths shall go forth energetic, ready for everything, apt, industrious, and worthy of being intrusted with the duties of life.[4]

Jean Jacques Rousseau (1712–1778) was the next significant figure to contribute a philosophy in the development of science teaching. Along with Johann Bernhard Basedow (1723–1790), who first actually attempted to put these naturalistic doctrines into practice in his Philanthropinum, Rousseau was the most influential thinker in the field of education in the eighteenth century. His best exposition of his educational views was set forth in *Emile,* published in 1762. This work has become one of the greatest classics in the field of education. Brubacher emphasizes the extent of this influence as follows:

> But while Comenius and Locke had been chiefly interested in the senses as the portals through which knowledge entered the mind, Rousseau inclined to think true education consisted less in knowing than in doing. Hence, he went on to include within his method those inner senses or springs of action better known as feelings. In making this inclusion he introduced a romantic note into educational method, the effects of which have not worn off in the twentieth century.[5]

This doctrine of naturalism proposed to give the child freedom to develop his natural endowments, to cultivate his natural capacities, and to follow his natural inclinations. In the words of Rousseau:

> Education by nature will restore the natural unsophisticated man, whose sole function is to be a man. In the natural order of things, all men being equal, their common vocation is manhood; and whoever is well trained for that cannot fail to perform any vocation connected with it. Whether my pupil be destined for the army, the church, or the bar, is of small consequence. Regardless of the calling of his family, Nature calls him to human life. To live is the craft I desire to teach him. When he leaves my hands, I admit he will be neither magistrate, soldier, nor priest; he will be, first of all, a man; all that a man may be, he will be able to be, as well as any one.[6]

The latter part of the eighteenth century gave us the philosophy and thinking of Johann Heinrich Pestalozzi (1746–1827). His experiences at the institute at Yverdon, Switzerland, led him to abandon the older methods of the deductive approach in favor of the inductive method. Brubacher interprets this philosophy as follows:

> The only way to correct this misunderstanding [in the meaning of words] between the teacher and pupil, according to Pestalozzi, was for the teacher to commence with sense impressions of the object of the lesson. Only after time for these impressions to take effect had elapsed should the teacher proceed to the naming of the object. Once named, the object could be studied as to its form, that is, its various qualities could be discussed and compared. Finally, with the abstraction of its essential as against its accidental qualities, the object was ready for definition. This, in brief, is what Pestalozzi so frequently refers to as the essence of his method, teach-everything through number, form, and language.[7]

His chief contributions to the teaching of science, therefore, were that children should study the real objects in their experience, they should learn through all their senses, and they should be allowed individual expression of ideas. His method of object teaching was the forerunner of our present approach to the teaching of general science.

Friedrich William Froebel (1782–1852) based his thinking on the works of Rousseau, Basedow, and Pestalozzi. He taught

[4] S. S. Laurie, *John Amos Comenius,* cited by Wilds, *op. cit.,* p. 337.

[5] Brubacher, *op. cit.,* p. 208.

[6] J. J. Rousseau, *Emile,* cited by Wilds, *op. cit.,* pp. 386–87.

[7] Brubacher, *op. cit.,* p. 213.

us that education was a process of creative self-development. Froebel contended that children learn by doing, but the task of the outstanding teacher was to motivate the children to use every potentiality inherent in their nature. This principle of unfolding self-activity is expressed in these words:

> All the child is ever to be and become, lies in the child, and can be attained only through development from within outward. The purpose of teaching and instruction is to bring ever more out of man rather than to put more into man.[8]

Since Froebel's curriculum was an activity curriculum, the study of nature's objects became the study of living and growing plants and animals. This principle is now generally accepted as a part of science instruction.

Although the scientific awakening following the Renaissance had been reflected in the work of the sense realists, the naturalists, and the developmentalists, scientific studies were introduced into the schools slowly and against much opposition. This period of scientific determinism in the nineteenth century gave us the thinking of two brilliant English educators. Herbert Spencer (1820–1903) was probably the most influential educator of this period in demanding that the new scientific content be given a more conspicuous place in the schools. In his essay, *What Knowledge Is Worth Most,* he gave the teaching of science its modern place in the curriculum. Our modern concepts and objectives of science education are based on his five types of knowledge or activities:

1. Those leading directly to self-preservation.
2. Those leading indirectly to self-preservation.
3. Those leading to parenthood and rearing of offspring.
4. Those leading to the proper use of leisure and enjoyment of the finer things in life.
5. Those leading to useful and active citizenship.[9]

Thomas Henry Huxley (1825–1895) based his arguments for the inclusion of science in the curriculum on the fact that England, the home of the Industrial Revolution, was shortsighted in failing to include instruction in physics and chemistry in its schools. He pointed out that these were the scientific roots from which the industrial and commercial greatness of the country had developed. Both Spencer and Huxley urged the abandonment of much of the traditional literary curriculum in favor of the more pragmatic scientific curriculum. In the words of Huxley:

> That man, I think, has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great fundamental truths of Nature, and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of the tender conscience; who has learned to love all beauty, whether of Nature or of Art, to hate all vileness and to respect others as himself. Such an one, and no other, I conceive, has had a liberal education; for he is as completely as man can be, in harmony with Nature.[10]

II. Factors Influencing the Development of General Science.

In a study based on textbooks and curricula Hunter lists the following periods in the development of modern science teaching.[11]

1. 1870–1890: The period of comparative anatomy and plant analysis. In this period the study of botany flourished.

2. 1890–1900: The period of laboratory study of types. In this period plant and animal morphology was emphasized.

3. 1900–1910: The period of plant and animal physiology. In this period there

[8] F. W. Froebel, *The Education of Man,* cited by Wilds, *op. cit.,* p. 485.

[9] H. Spencer, *What Knowledge is Worth Most,* cited by Wilds, *ibid.,* pp. 523–24.

[10] T. H. Huxley, *Science and Education,* cited by Brubacher, *op. cit.,* p. 479.

[11] G. W. Hunter, *Science Teaching at Junior and Senior High School Levels,* New York: American Book Company, 1934, pp. 24–25.

was a predominance of teaching physiology by the laboratory method.

4. 1910–1920: The period of the correlation and application of biology. Here we find the human applications of biological subject matter with emphasis on the side of human interests.

5. 1920–to present: The period of the rise of unified science. This is the period in which unified science in the biological and physical areas appeared, and general science appeared in the curriculum of the junior high school.

To better understand this establishment of general science in the junior high school, it is necessary to briefly consider the nature-study movement in the elementary school.[12] About 1870, Superintendent Harris introduced natural science into the curriculum of the elementary schools of St. Louis. It was a highly formalized type of science teaching stressing the classification of organic and inorganic objects. It was based on the Pestalozzian principle of object teaching. But the emphasis was on mastering scientific classification and terminology. This type of teaching was bookish, formal, and analytical, far beyond the comprehension of most children. An example quoted by Wilds well illustrates this point:

> For example, if common salt were the object of the lesson, the children would be expected to learn its chemical composition, its uses, how and where found in nature, how mined and refined, that its crystalline form is cubical, that it varies in color from white to bluish and reddish, that it is transparent to translucent, that it is soluble in water and saline in taste, that it imparts a yellow color to flame, etc., without more contact with a piece of real salt than seeing the "specimen" passed around by the teacher.[13]

At Oswego Normal School, New York, in 1876, Straight began to develop methods of studying objects in their interrelationships in place of merely studying disconnected and isolated objects and facts. His influence was felt as the nature-study movement gained headway during the period from 1884–1890. It developed almost simultaneously in a number of schools in the country.

Jackman in the Cook County Normal School, Illinois, in 1899, emphasized nature study as an important element in the elementary school curriculum. He believed in a wide range of experiences with nature's activities rather than in a detailed study of a few lifeless forms. He suggested that children study natural phenomena as they meet them, rather than in a predetermined order based on their scientific relationships. By the end of the nineteenth century the nature-study movement had spread to a large number of schools in many states and had become an important consideration in the new elementary school curriculum.

Another factor which must be related at this point is the movement to establish the junior high school as an administrative unit. As is stated in the Thirty-First Yearbook:

> General science . . . cannot be separated from the evolving junior high school, since the rise of general science has been practically coincident with that of the junior high school, and since, moreover, the subject has been developed with an increasing regard for the aims and needs of that school.[14]

Towards the end of the nineteenth century, President Eliot, of Harvard, stated that secondary education should "dip down" to include the last two years of the elementary school. Other colleges throughout the country were concerned with the same problem. This gave rise to the "Committee of Ten," in whose report it was pointed out that each of the groups of experts submitting reports upon the work of the high school subjects was anxious that the work in its particular field should begin earlier than was then customary.[15]

[12] W. C. Croxton, *Science in the Elementary School*, New York: McGraw-Hill Book Company, Inc., 1937, pp. 21–29.

[13] E. P. Cubberly, *Publication Education in the United States*, cited by E. H. Wilds, *op. cit.*, p. 481.

[14] S. R. Powers and Others, "A Program for Teaching Science," *Thirty-First Yearbook of the National Society for the Study of Education*, Part I, Bloomington, Illinois: Public School Publishing Company, 1932, p. 126.

[15] C. W. Eliot (Chairman), *Report of the Committee on Secondary School Studies*, Washington, D. C.: Government Printing Office, 1893.

Butler, making an address in 1898, on the scope and function of secondary education, proposed that elementary education should last from the age of six or seven to the period of adolescence, and give general training in the elements of knowledge. Adolescence, occurring at the age of twelve or thirteen and continuing to sixteen or seventeen, should determine the period and nature of secondary education. As an administrative setup he proposed the 6 – 6 plan.[16]

In 1903, a committee was appointed by the National Education Association to investigate certain aspects of the junior high school movement. It studied the 8 – 4 plan and the 6 – 6 plan and, although a definite recommendation was not forthcoming, it seemed to favor the 6 – 6 plan.[17] After 1900 the junior high school movement rapidly gained headway. Snedden,[18] Lyttle,[19] and Morrison [20] all proposed the 6 – 6 plan of school organization for the elementary-secondary school division.

Cities pioneering in the establishmbent of the three-year junior high school as a separate administrative unit, as we understand the organization today, were Columbus, Ohio (1909), Berkeley, California (1910), Concord, New Hampshire (1910), and Los Angeles, California (1911). By 1916, a survey showed that 189 cities had the junior high school more or less well organized.[21] The idea of a school to bridge the gap, concurring with the adolescent period of children, between the elementary school and the high school was accepted and school administrators were ready to adopt this plan all over the country.

With the establishment of the junior high school the teaching of science had to undergo adaptive changes to meet the needs of this new emphasis in education. As was pointed out previously, nature study had become an accepted part of the course of study in the elementary school. This type of science teaching had, of course, a great influence on the science offerings in the junior high school. But at the same time systematized, special sciences had become firmly fixed in the curriculum of the high schools. This technical science-teaching movement had spread from the colleges and academies to the high schools. The influence of this movement was also felt in the junior high schools.

As a result of these two forces, educators had to look for a new direction in their thinking. If the junior high school was to become a new type of school suited to the needs and interests of a particular group of adolescents, science could not be nature study, and it could not be specialized science. Fortunately, at that critical time a committee of the Central Association of Science and Mathematics Teachers was studying the question of unified science for the Ninth Grade in high schools. The report of this committee recommended that the first year science course should be organized upon a broad basis involving fundamental principles of the various sciences and using material from all, if needed. Certain large units were to be selected for study. These were to have coherence in themselves, and were to be so chosen as to allow of the scientific interpretation of the more common experiences of the pupils. Use of materials from all sciences, nature study as well as the specialized sciences, was suggested in building this course of study.[22]

[16] N. M. Butler, "The Scope and Function of Secondary Education," *Educational Review*, 16: 15–27, 1898.

[17] "The Junior High School," *Fifteenth Yearbook of the National Society for the Study of Education*, Part III, Bloomington, Illinois: Public School Press, 1916, p. 11.

[18] D. S. Snedden, "The Six-Year High School," *Educational Review*, 26:525–29, December, 1903.

[19] E. W. Lyttle, "Should the Twelve-Year Course of Study Be Equally Divided Between the Elementary School and the Secondary School?" Cited in the *Fifteenth Yearbook*, *op. cit.*, pp. 428–33.

[20] G. B. Morrison, "Report of the Committee on an Equal Division of the Twelve Years in the Public Schools between the District and High School," cited in the *Fifteenth Yearbook*, *op. cit.*, pp. 705–10.

[21] *Fifteenth Yearbook*, *op. cit.*, *pp.* 25–27.

[22] O. W. Caldwell (Chairman), "Preliminary Report of the Committee on a Unified High

Shinn, in his report to the Illinois Academy of Science in 1914, best summarizes the meaning of unified science:

> . . . it may be stated that by "unified science" is not meant a uniform, standardized, "cut-and-dried" course for all teachers, all classes, and all localities, but a science, the parts of which are not integers but fractions, not isolated subjects taught by trained specialists, but are portions of a broad subject, science, taught by men who specialize in the general education of youth.[23]

Thus, about 1910, general science began to develop in Grade IX, and within a few years found its way into the material taught in Grades VII and VIII. In 1920 the Science Committee of the Commission on Reorganization of Secondary Education recommended the sequence and content of science courses that we generally follow today. In this report specific recommendations for the teaching of general science in the Seventh, Eighth, and Ninth Grades are found.[24] The twenty-year period between 1910 and 1930 was, therefore, a period of experimentation in the organization of general science offerings in the junior high school. A new direction in the thinking of educators had been adopted, and schools were experimenting with these new concepts of teaching. In 1930 the National Society for the Study of Education appointed a committee of outstanding science educators to study and report on science programs at all levels of schooling. The Thirty-First Yearbook includes recommendations for junior high school general science courses.[25]

Hunter made a study of the extent of general science offerings in junior high schools in 1932. He surveyed 527 schools all over the country and found that 442, or 83.9 per cent offered a general science in the curriculum.[26] Kambly made a more recent study of the organization and extent of junior high school science in 1944. His findings indicate that there was little change in that period since the percentage of general science offerings at that level remained at 85 per cent.[27] In 1947 the National Society for the Study of Education published its Forty-Sixth Yearbook dealing again with science education. This report by leaders in the field of science teaching once more has an entire section devoted to the teaching of science in the junior high school.[28]

In summary, it might be stated that science education, in general, developed as a result of the practices and philosophy of a number of great teachers and educators during the last 300 years. General science, in particular, developed as a concomitant outgrowth of the junior high school movement. This new administrative organization demanded a new type of science teaching based on the best practices derived from the nature-study movement in the elementary schools and the specialized-science movement in the high schools. The greatest contribution of the committees of outstanding science educators studying the teaching of general science was to bring out the principle that we should no longer emphasize distinctions between various grade levels of science teaching but that we should think of science as a twelve-year integrated program for all children in the schools. The importance of science in

School Science Course," *School Science and Mathematics*, 14:166–68, February, 1914.

[23] H. B. Shinn, "The Movement Towards a Unified Science Course in Secondary Schools," *School Science and Mathematics*, 16:778–82, December, 1914.

[24] O. W. Caldwell and Committee, *Reorganization of Science in Secondary Schools*, Washington, D. C.: United States Bureau of Education, Bulletin 26, 1920.

[25] *Thirty-First Yearbook, op. cit.*

[26] G. W. Hunter, "Science Sequences in the Junior and Senior High Schools," *School Science and Mathematics*, 33:214–23, February, 1933.

[27] P. E. Kambly, "The Junior High School Science Program," *School Science and Mathematics*, 44:225–31, March, 1944.

[28] V. H. Noll and Others, "Science Education in American Schools," *Forty-Sixth Yearbook of the National Society for the Study of Education*, Part I, Chicago: University of Chicago Press, 1947.

the lives of these children is well illustrated in the following passage:

Perhaps the most distinctive characteristic of the modern world is its increasing dependence upon science. If the last three centuries are an index of what the next three are liable to be, science is destined to affect greatly, if not to remake, nearly all the areas of life. Only as we understand the impact of science on society, can we shape the future course of events so as to maximize the benefits of advancing scientific knowledge for the satisfaction of common human needs.[29]

[29] *Education and Economic Well-Being in American Demcoracy,* Washington, D. C.: Education Policies Commission, National Education Association, 1940, p. 40.

AN ATTEMPTED METHOD FOR COUNSELING IN THE CLASSROOM

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ONE cannot teach very long without becoming aware of the varied behavior patterns exhibited by students in the everyday classroom. Why do certain students conform to classroom situations and routines while others tend to the opposite extremes? What are the reasons behind such actions which arise in the ordinary classroom? Is the teacher at fault? Is the student at fault? Is it, perhaps, the expression and release of certain tensions which are expressed by both the teacher and the student in a classroom situation? These questions and other similar ones have bothered this teacher frequently.

Lack of understanding of human behavior by the teacher probably causes most teachers to take the wrong course of action, thus creating a more undesirable situation than existed previously. Lack of information by the teacher probably increases anxiety and insecurity which naturally places the teacher in a defensive position in order to protect his self esteem. If the teacher knows and understands human behavior basically he can interpret the situation to himself, and to the class if need be, thus eliminating hostile reactions arising in a teacher-class situation.

Psychological and psychiatric literature deals primarily with case histories and analyses of situations, but no clear-cut method is included for a teacher to use in attacking many of these classroom problems. The distance between psychology, psychiatry, and the school situation is separated by a wall of terms which prevent application of principles from these fields to educational functions. The reading by most teachers of psychological and psychiatric literature leaves them at a loss as to the interpretation of such information. If the teacher is practical, he will, of course, keep asking himself, "How can I use this information in my teaching?"

To try and bring one phase of the two together in a practical way is the hypothesis which the author would like to present in this article. It is believed that the attempted method for counseling students during class time has many advantages which have not been heretofore realized by the average teacher. If one has a flexible method of approach in the solving of existing problems then, most likely, improvements can follow. It is hoped that this idea might be an "ice-breaking" mechanism being tried to "bridge-the-gap" between the theoretical and the practical in so far as teaching is concerned. To try and bring one phase (counseling) of the two together in a practical situation may be taking too much license by an ordinary classroom teacher who lacks the formal training in psychology and psychiatry; however, the need exists and when that need becomes great enough

a form of expression is the result. It is well realized that no method is infallible, or will work in every situation, or solve all of the existing problems of teachers.

The awareness of the teacher regarding various types of behavior patterns naturally makes him cognizant of this important problem. Immediately it is apparent that the application of psychological methods to classroom teaching presents a problem of no mean proportion to the teacher. But realizing the classroom problems and those more serious cases with which the teacher must deal on occasion makes it almost imperative that we have a knowledge of some direct approach to the handling of such situations. It is not to be construed that this method of counseling students in the classroom is designed only for discipline cases, but also, and probably as important as to help the average and superior students to be better understood.

The writer has constantly in his teaching tried to evaluate student behavior and to understand that behavior in terms of the students' experience. The idea was developed, over a period of three years, that there must be a weakness in understanding adolescent behavior in the classroom. Several aspects of adolescent behavior was investigated without improvement except in the area of the students' background. This incompleteness of understanding resulted in a series of instruments to be used to try and overcome this suspected weakness. To remedy this situation then the goal must be one of understanding the individuals' socio-economic background and how he has integrated his socio-economic patterns into his overt behavior in the classroom one hour each day. In other words, to draw out the individual as to his interpretation of the situation and then to resynthesize his patterns of behavior in accordance to the group patterns seems to be the problem which this method has attempted to work out to a satisfactory conclusion. This method consists then of the use of a series of instruments which the author has found useful in promoting greater rapport between the pupil and the teacher. Perhaps this method will not work for other teachers, but it would be of great interest to the writer if they would attempt to use it and report their results to him. In general the plan consists of:

1. Developing group dynamics and rapport
2. Giving information on a personal questionnaire
3. Writing an autobiography
4. Rating blank sent to homeroom teachers
5. Rating and diagnosis of work every nine weeks
6. Interviewing each student
7. Evaluating each individual in terms of follow up

The development and execution of group dynamics and rapport was planned with care. It was the belief that the success of the remainder of the plan rested on this initial phase of socio-interpersonal reaction. In developing this basic idea, the interpersonal was brought into discussions as a part of group dynamics. In order to accomplish this in the classroom, several devices were used with varying amounts of success at the beginning of the school year.

The first period was used for getting acquainted. The students were asked to stand and give their names and tell one thing they liked and one thing they disliked. The teacher started the "ball-rolling" by telling of an embarrassing experience. Some of the students were slightly embarrassed, but it was a good technique to have some laughs and release first tensions created by a new class and unfamiliar faces. A note was made, by the teacher, of those who appeared shy, reticent, ill-at-ease, backward, or bashful, with the end in view of helping these students in later class periods.

The next class period was used to explain and to have the students understand the

dynamics of group discussion.[1] The opening remarks were in the form of questions such as: "What makes a discussion interesting?", "Who should take part in a discussion?", "What are the reasons for discussions?" and "What are the mechanics of a good discussion?" At the end of the period the teacher lectured and summarized the dynamics of group discussion. The summary statements were written on the blackboard.

The next day there was a brief review of the previous day's work and the main points were reemphasized. This gave the teacher a good idea of how much the students retained from the material covered the previous day. The discussion was directed to the question of what makes a good student and what makes a poor student. A recorder was selected by the class, and the two contrasting types of criticisms, (that is, what makes a good student and a poor student.) were written on the blackboard by the recorder. The idea of what makes a good teacher and a poor teacher was put before the group by the teacher, but discussion was gradually shifted to the recorder, who acted as the group leader. During this time the teacher had moved from the front of the room to the side of the room as unobtrusively as possible and without the students' becoming aware of the shift from a teacher-pupil discussion to a pupil-to-pupil discussion.

The following day was spent outside on the lawn with the group arranged in a circle. The idea presented was the part that social factors played in group dynamics with the discussion led and directed by the teacher. The main point was to impress the students with the over-all idea *that classroom behavior is a direct product of the students' psychological, hereditary, and socialized personality characteristics brought into the classroom and integrated, to a lesser or greater degree, into the group for the purpose of learning something about biology.* Such topics as: "What effect does the home have on group discussions?" "What are the effects of the home on sibs, religion, other classes, teachers, and other environmental factors?" At various times during the discussion, and when summation was necessary, the teacher pointed out the various psychological and sociological factors at work in the group processes. It was realized by the students that they did not leave their "home-personalities" at home or their "recreation-personalities" outside the school but that in the classroom they were a composite of all their personalities. It might be said that some of the students had their personalities a little out of balance, especially in the direction of "recreation-personalities". The integration of their respective personalities into a composite group for class work and discussion was in a large measure accomplished by this method.

The next phase of this introductory work was teacher-student planning which this teacher believed instrumental in furthering rapport. This type of activity has been used advantageously when the teacher has not taken the idea of teacher-student planning too literally. By this it is meant that the students could not see the aims and objectives of some lessons, but, if the teacher used the "power-of-suggestion", the students benefited from sharing in an activity which formerly was thought of as strictly teacher domain. This teacher had an unfortunate experience using this method. After reading some books on the psychology of learning, the teacher proposed to have the pupils do the planning and executing of the following units' work. The students were asked to do some reading, followed by discussion of the unit. The student unit failed because the students could not understand logically the sequence of development of certain ideas in connection with the unit. However, in spite of a failure, this teacher would not give up the idea of teacher-student planning. For the

[1] Clark, Zander, Morse, and Jenkins, "Psychology of Group Behavior". *Journal of Educational Psychology, October,* 1950, 41:332–338.

next unit, some time was spent by the teacher talking about the more interesting phases of the unit; then when the plan was discussed with several alternate plans, the majority of the students compromised and enlarged the plan which the teacher had prepared them for previously. It was believed that the students still felt the responsibility for the planning and development of the unit; moreover, the teacher felt that useless expenditure of time was avoided.

At predetermined intervals and at the opportune times various instruments were used to help promote individual rapport. The first instrument was a mimeographed questionnaire [2] which touched on various phases of the students background, such as home, recreation, religion, work experience, health, philosophy, et cetera. It was explained to the class that this questionnaire gave the teacher some information which was beneficial to him in getting to know each student individually. The sincerity of the teacher in wanting to know the student and some of his interests was stressed; moreover, this method, or this tool shortened the usual time taken to become personally acquainted with the student.

The second instrument used to gain rapport was the autobiography. As assistance three questions (which the students did not necessarily have to use) were given as a guide in its writing. The questions were: (1) Describe the most outstanding incident in your life. (2) Describe the person you admire most and tell why (3) What would you like to do most when you graduate from high school? In studying the various autobiographies the teacher found that the second question was the most informative in understanding the student. The pupil usually admired someone that he would like to emulate. A comparison of his answer might be made with question number eighteen on the personal questionnaire. Some students wrote a great deal, others wrote very little, but whether any significance could be attached to this, it would be difficult to say. The more superior students had a tendency to write more about themselves than the poorer students. The autobiography gave the student who was too shy to talk a chance to express himself; moreover, some students wrote information which they did not reveal at any other time. As such, the autobiography had a limited use, but as a method which helped the teacher to understand the student it was of great assistance. When the teacher interpreted rather than *just read* the autobiography and correlated this information with the other instruments, he was able to get a more complete picture of the student in all of his spheres of activities. This device was one of the useful tools used in integrating the multiple factors into a common denominator of understanding.

The third method used in the plan was a progress rate sheet which helped engender the idea of each student's responsibility for his grades. Some students did not assume responsibility very readily. It was thought that if, through a personal motive of grades, responsibility developed, it would be worth the effort expended. However, even those students who had a strong sense of responsibility liked the idea of knowing how they were progressing each nine weeks. This rating sheet was passed out, explained, and discussed. The discussion was centered around the use of the rating sheet and how it might help the student to improve his work. The majority of students were eager to improve themselves and their work; however, they needed help in this area, particularly with specific objectives, in order to improve their work. The idea was stressed that this rating sheet was an individual diagnosis of the student's work based on the teacher's opinion. If the teacher and the student worked together in this area, the student accomplished the objectives set up for the course much more easily than if he blindly attempted them alone. These rating sheets did not replace report cards but, rather, supplemented

[2] W. D. Lefever, A. M. Turrell, and H. I. Weitzel, *Principles and Techniques of Guidance*, New York: Ronald Press, 1941, pp. 485–498.

them and gave the student specific objectives for self improvement. The comments were of a positive nature; that is, when a student was doing poorly he was told specifically what to do to raise his standard of work instead of being told that he was doing poorly. If the student realizes that his grades are determined by him, then the teacher has accomplished a major task of educating the student in making his "own breaks", and a further step has been taken towards adult emotional stability.

A fourth instrument to be used was the personal interview. A question sheet was mimeographed and answers recorded during the interview. The reason the same questions were used for each student was to insure fairness and accuracy, to limit the interview, to be able to compare and review answers, and to serve as a guide to an inexperienced interviewer. The students were told that each one would have a personal interview and that they should think of questions they might like to ask which they would not ask before the class as a whole. These personal interviews were probably the strongest link in gaining rapport with the students.

The questions were arranged in a particular order to accomplish certain objectives. The objectives were: (1) stressing the interests of the student, (2) drawing out students as to personal likes and dislikes, (3) trying to place the responsibility of grades on the student, (4) leaving the opportunity open for further conferences on the initiative of the student. It was hoped the student realized that the grade he gave and the grade the teacher gave coincided so that he was aware of how and why he received his grade. In fact, there were very few instances when the teachers' grades did not coincide with those of the student. It was found on closer investigation that those students who did not estimate their grades correctly were the students who usually revealed some underlying emotional or mental problems. This method of grading instilled in the student the idea of mutual cooperation in establishing his grade. The teacher, during the interviews, tried not to register surprise or to admonish the student in any way. The teacher asked no questions other than those which appeared on the form. Some of the answers to the questions were used for future reference; for instance, when class work called for such skills and knowledge. The personal interview took place during class study periods. Most of the students expressed much interest in these interviews and several students voiced opinions that there be more time allotted for such inquiry. There was only one personal interview per student attempted during the school year because of the amount of time involved; the single interview usually took twelve to fifteen minutes.

As additional information for the teacher's benefit and overall perspective, the student's health and office records were checked and a rating blank was sent to each homeroom teacher. With this combined type of information, it was hoped that the classroom teacher gained more balanced and unbiased perspective of the "whole" student.

Following this brief explanation of the method used in class periods to help the teacher and the students develop a better understanding of the emotional problems involved in every day class work, one should ask himself, "Did it really work?". It should be stated that this method did not solve all the classroom problems; however, the solution to these problems gave a better basis for working out a more satisfactory solution to problems which arose later. With this type of material "on tap", the teacher had a better understanding of how to meet the arising needs of each student. For example, there was a student who liked to draw, so he was given as many opportunities as possible to draw and, as a result, he attacked some of his other less desirable work with more zeal. One girl was interested in designing and, when it was pointed out to her that animals became furs and plants became fabrics, she took a renewed interest in biology. In as many

cases as possible the knowledge which was gathered concerning the students' interests was integrated into a single purpose. Thus the aims and goals of biology were reached, and at the same time the interests of the students were taken into consideration and furthered as much as possible.

> Arbuckle in his book, *Teacher Counseling,* says, "The new teacher is not considered in this text as one who is necessarily young in years, or young in service. He is rather an individual who possesses a firm belief that his job is to assist children to help themselves toward optimum adjustment in the daily tasks of living now and throughout their lives." [3]

By this advanced type of planning, a great deal can be accomplished for the student as well as reaching the goals of biology.

It was hoped that a certain degree of rapport was established by this method. The teacher felt that he knew more about the student and why he reacted in a certain way and, as a consequence, the teacher became more tolerant of individual students' behavior. The feeling of understanding which developed between the teacher and the student also developed a greater sense of responsibility on the part of the individual student in the class. This was demonstrated in various ways such as having a student chairman on certain days, expressing themselves more freely, and the feeling that the student had a share in conducting the class. The individual students responded more whole heartedly to outside projects and brought to class current materials which were of general interest to the whole class. To be sure, the usual classroom problems existed, but not one of them assumed the same proportion as in previous years of teaching.

This method of approach to the understanding and handling of classroom behavior naturally gave the teacher a feeling of greater security. The author felt that in a very short time he knew each student and a mutual sharing of personal things was prevalent which brought the students into a closer relationship with the teacher. This "advance" knowledge of the student made the teacher look and study each student as a whole individual rather than compare the individual to the group.

The author tried to bring the incentives and goals of the student into the total goals of the group. Sometimes certain students had deviate personality patterns which brought them into conflict with the accepted group patterns of behavior. If these individuals were helped by bringing them into group cooperation then it must be admitted that a worthwhile goal was accomplished. Of course, the degree of aberration also played its part in this type of corrective work within the ordinary classroom. It was not thought that the classroom should be a class in psychotherapy but, if one individual was helped, the effort was worth the price. Referring to *Personality and Behavior Disorders,* Doctor Stevenson says:

> It is chiefly important that "presumptive prevention" be recognized for what it is. If, for example, the shut-in child is to be dealt with on the one hand by the chance buffets of parents, teachers, or companions, or else on the other hand by a designed attempt to bring him into close, more comfortable touch with others, it is better to follow the latter course even though it is a presumptive prevention, for at worst, it is likely to be no worse than the former, and in any case our knowledge of such children is enriched by the attention of the problem———
>
> According to another concept of prevention, it is considered that a disorder may be forestalled by treating a definite but simpler or earlier disorder. This might be called "therapeutic prevention". It is only relatively preventive in that a problem has already arisen. It depends for its rationale upon the fact that most disorders of personality and behavior are progressive. They seldom burst forth on short notice in full form, although, there are clear-cut instances of this, but rather they are cumulative, one step in a series leading to another. *By treating one step the next is prevented. . . .*" [4]

[3] Dugald S. Arbuckle, *Teacher Counseling,* Cambridge, Massachusetts: Addison-Wesley Press Inc., 1950, p. 111.

[4] Stevenson, George S., M.D., "Prevention of Personality Disorders", *In Personality and Behavior Disorders,* J. McV. Hunt, (Ed.), New York: Ronald Press, p. 1168.

Therefore this type of attention given to every student made him feel that he was being treated as an individual and not just another student in a group. This personal relationship instituted in the beginning of the school year helped to create a firm foundation for further growth in interpersonal relations.

Perhaps it could be said that most students need this type of personal attention which is ordinarily lacking in the classroom. The needs of the student must be considered on an individual basis.

It was thought by the writer, that this method gave the student some insight into his own personality. In connection with this idea, time was spent during the year studying personality and personal adjustment as a climax to the study of the human body. Such preparation developed in the student the idea that he made his own place in the classroom and received what he earned rather than using the many rationalizations which are so common with students. This insight gave the student a different awareness of his obligations to his classmates.

Many of the students had the habit of dropping in after school, or at odd times, and talking over some of their problems. At first, it was usually something of little consequence, but after sufficient time they usually revealed their problems when they found no reproaches, condemnations, or rushing them in regard to their problems. Several students developed a more mature, emotional outlook toward many of their problems and became independent of the teacher's help when they worked out their own solution to their respective problems. Four students were helped in this way; however, if only one had been helped, it would have been well worth the effort expended on the project. This growing in responsibility and, in some cases, emotional maturity should be a definite part of the school's job if we are to teach democratic processes and thus prepare students for an effective adult life. Growth in responsibility improves emotional health which is so necessary in our educational system. An awareness on the part of the students of their responsibilities, plus some insight of their personalities, would benefit each student immeasurably; this is however, one of the areas in school education which is most often neglected because of poor coordination and organization of this highly important area.

In summary, it may be said that a method for counseling students in the classroom has been developed and tried. Whether or not this method would be successful for others is one of the questions which the author has not answered.

Conclusions:

1. A method has been tried for counseling students during regular class time.

2. An attempt has been made to "bridge the gap" between psychology, psychiatry, and teaching.

3. The author feels that this method has worked for him moderately well, but would it work for others?

4. It is believed that the students benefited from this experience as a growth process in a poorly understood area of emotional health.

The following forms are the ones the author used in this project:

PERSONAL QUESTIONNAIRE

1. Your name ....
   Hour ...... Biology or Nat. Study
2. Do you assist with home duties? ......
   About how many hours a week? ......
3. Do you work for pay outside your home? ...
   On the average, how much pay do you earn per week? ....
   Type of work? ....
4. Name three subjects which seem most worthwhile to you.
   1.
   2.
   3.
5. Name any which seem of little value to you.
   1.
   2.

6. Check, at left, possible causes of your present difficulties with school subjects, as listed below:

...... 1. Am not interested,
...... 2. Do not understand the work
...... 3. Do not get along well with some teachers
...... 4. Have difficulty with reading
...... 5. Explanations not clear
...... 6. Am bored
...... 7. See no reason for taking this subject
...... 8. Have fear of failing
...... 9. Worry over grades
......10. Do not have quiet study place at home
......11. Do not like to speak before a group
......12. Do not like some teachers
......13. Hard to keep mind on work
......14. Too much to do

OTHER REASONS (Please name)

15.
16.
17.
18.

7. For the most part, are your grades:

...... above average
...... average
...... below average

8. List any hobbies or interests which you especially enjoy.

1. ....
2. ....
3. ....
4. ....

NOTE: Go back over your list and check those which you would like more help or time in school.

9. Are you often absent from school? .... If so, check or write in reasons below:

1. Illness of self
2. Illness of others in the family
3. Duties at home
4. Work (outside of home)
5. Transportation difficulties
6. Cutting
7.
8.

10. What qualities or traits do you like in a teacher?

1.
2.
3.

11. What qualities or traits in a teacher do you dislike?

1.
2.
3.

12. Check at left any of the following in which you would like more help.

...... 1. Working periods
...... 2. Getting along well with others
...... 3. Conduct between boys and girls
...... 4. Social dancing
...... 5. Personality development
...... 6. Personal attractiveness
...... 7. The human body and how it functions
...... 8. Sex education
...... 9. Getting along at home
......10. How to study

OTHERS:

......11.
......12.
......13.

NOTE: Place a second check by the three which you especially wish help.

13. List in order of choice ways in which you would like to use your leisure time.

1.
2.
3.

14. What do you talk about most with your friends?

1.
2.

15. What "right" which you do *not* have at the present time, do you think you should have?

1.
2.
3.

16. If you could have three wishes, what would you choose?

1.
2.
3.

17. What do you like best about your school?

What do you like least about your school?

18. What do you plan to do when you graduate from high school?

1.
2.
3.

If you do not plan on finishing high school, what are your plans for the future?

1.
2.
3.

19. What would make biology more interesting to you?

1.
2.
3.

20. What are your weaknesses?

1.
2.
3.

CLASSWORK RATING

NAME ____________ HOUR _____ BIO/N.S. DATE ____________

This is not a report card! This is a progress rate sheet. This is an attempt to help you understand how well you are doing in class and possibly point out some ways for your improvement. This is a rating of your individual progress and cannot be thought of in terms of a comparison of yourself to the class, because then you defeat the very purpose of this rating sheet (this is a diagnosis of your individual work in class). I am here to assist you and to help you be self-reliant, responsible, and tolerant.

1. TEST AREA

0 Below Av. Above 100

Comments:

1. Excellent ____________
2. Good ____________
3. Average ____________
4. Below Aver. ____________
5. Poor ____________
6. Need help ____________

2. WORKBOOK AREA

Comments:

1. Uses references — Not any
2. Completes daily work — Does not
3. Persistent — Not
4. Accurate — Inaccurate
5. Does not copy — Copies
6. Understands — Does not
7. Extra work — None

3. CLASS WORK AREA

Comments:

1. Aids in discussion — Never volunteers
2. Attentive — Inattentive
3. Contributing — Non-contributing
4. Has understanding — Lacks understanding
5. Uses scientific method — Lost

4. ATTITUDE AREA

Comments:

1. Respects others — No respect
2. Wants to learn — Negative
3. Class behavior excellent — Poor
4. Shows initiative — Indifferent

HOMEROOM TEACHER RATING

Name ____________ Biology or Nature Study ____________

Hour ________ Homeroom teacher ____________ Homeroom number ____________

I.Q. ________ Date ____________

Please check ( ) on this scale the traits which apply to this student

1. Is this student cooperative? ________ — very uncooper. | uncooper. | cooperative | most cooper. | very coop.

2. Behavior? ________ — very bad | noisy inattentive | noisy at times | fairly quiet | quiet | very quiet | extremely quiet

3. Is this student cheerful and happy? ________ — despondent | moody | fairly cheerful | cheerful | mostly cheerful | always cheerful

4. Is this person conscientious about his work? ________ — not very | sometimes | reasonably | more | very

5. Attendance? ________ — very bad | poor | fair | good | very good

6. Does he or she like school? ________ — hate | dislike | undecided | about average | seems to | very much

7. Does he or she get along well with other students? ________ — very poorly | poorly | below average | average | fairly well | very well

8. Is this student dependable? ________ — very unreliable | unreliable | sometimes not dependable | about average | fairly depend. | very depend.

9. Other comments:

PERSONAL INTERVIEW

NAME ....PERIOD ....

1. Can you see any reason for taking biology? ....
2. What would you like to do best in biology? ....
3. Can you draw ...... paint ...... carve ...... models .... cut clippings .... scrapbook ...... collection (insects?) ...... make a report ...... write a report ...... tell an experience ...... read ...... work in workbook ...... other things (hobbies) ....
4. Are you having any difficulties in biology? ....
5. Why did you take biology? Credit ...... Recommended ...... Told Like ......
6. Do you like the way I teach this class? ......
7. How do you like to be treated? ...... (a) pushed or prodded ...... (b) left on your own ...... (c) work with another ...... (d) do you mind being criticized in class? ...... (e) do you mind following my directions? ...... (f) do you perform the tasks I ask willingly? ......
8. Do you like the students in this class? ...... Do they like you? ......
9. How would you describe your behavior in this class as compared to the other students? ...... Do you disturb the class too much by talking? ...... What should I do if I have to punish a person? ....
10. What grade do you think you deserve? ......
    a. have you taken part in class discussions? ......
    b. have you cooperated with the class and me? ......
    c. have you done your daily work? ......
    d. what is your average test grades? ......
    e. have you done some extra work? ......
    f. do you thing you have learned anything? ......
    g. are you attentive when I explain things? ......
11. Now, what grade do you think you deserve? ......
12. Will you stop by and see me sometime after school? ....

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THE NEED FOR SCIENCE CLASSROOM PROCEDURES IN THINKING

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THE development of "thinking" has been recommended as a desirable objective by numerous science educators for many years.[1] Consequently, one would suspect that the literature in Science Education would contain a significant amount of material concerning classroom procedures for the development of various objectives associated with "thinking."

In a recent study of the Science Education literature,[2] an analysis was made of the writings of twenty-eight science educators who had considered some aspect of "thinking" as an important objective of secondary science instruction. Though there was some difference of opinion concerning the nature and the range of validity of the "thinking" process there was considerable agreement in terms of attitudes and abilities which were believed to be common to a number of the following related forms of "thinking:"

1. Reflective Thinking
2. Critical Thinking
3. Logical Inquiry
4. Scientific Methods
5. Problem Solving
6. Scientific Thinking

For the purposes of this inquiry "thinking" or the "thinking" process is defined as the "finding and testing of meaning."[3]

The following attitudes and abilities are some factors in "thinking" which have been considered as important objectives for science instruction at the secondary level by some science educators.

Attitudes

a. Attitude of active curiosity
b. Attitude of active interest
c. Attitude of problem sensitivity
d. Attitude of recognizing effect of emotion on thinking
e. Attitude of intellectual honesty
f. Attitude of intelligent skepticism
g. Attitude of believing in cause and effect
h. Attitude of being cautious in problem solving
i. Attitude of possessing the disposition to solve problems
j. Attitude of basing judgment on facts
k. Attitude of suspending judgment until available facts are secured
l. Attitude of revising decisions if evidence warrants

Abilities

a. Ability to observe accurately
b. Ability to use materials
c. Ability to use language
d. Ability to recall selectively
e. Ability to handle assumptions
f. Ability to appraise problems and errors
g. Ability to plan and organize
h. Ability to formulate and test hypotheses
i. Ability to use deductive methods
j. Ability to use inductive methods
k. Ability to handle data

This particular organization of attitudes and abilities is not intended to be complete, nor is each of these characteristics necessarily a distinct or unique element in the "thinking" process. Any one classroom procedure may embody the collective development of a number of these factors in "thinking." Many of them are related to each other, and in practice, it is often difficult, if not impossible, to isolate them. No significance should be attached to their sequence. The purpose of the classification is primarily for identification and emphasis rather than separation. It should also be

[1] Heiss, E. D., Obourn, E. S., and Hoffman, C. W., *Modern Methods and Materials for Teaching Science*, p. 16.

[2] Krasnican, M. J., *A Study of some Factors in the Thinking Process as Objectives of Secondary Science Instruction and Suggested Classroom Procedures for their Development*, unpublished M.A. Thesis, The Ohio State University, 1950.

[3] Bode, B. H., *How We Learn*, p. 251.

noted that a classroom procedure is but one element in the teaching process. Other factors include teacher personality, student characteristics, and the school program.

Although a considerable number of science educators have proposed the said factors (attitudes and abilities) as desirable objectives for science instruction at the secondary level in the literature examined, relatively few of these writers have accompanied their recommendations directly with suggested classroom procedures. Tables I and II illustrate the lack of suggested classroom procedures accompanying the related objectives in "thinking."

TABLE I

SUMMARY OF FINDINGS CONCERNING ATTITUDES *

Recognized Attitude of:	Number of Sources giving Attitude as Science Objective	Number of Sources Suggesting Classroom Procedure with Objective
1. suspending judgment until available facts are secured	6	0
2. active interest	5	2
3. basing judgment on facts	5	0
4. revising decisions if evidence warrants	5	0
5. intellectual honesty	5	0
6. believing in cause and effect	5	0
7. being cautious in problem solving	5	0
8. active curiosity	4	1
9. intelligent skepticism	4	1
10. problem sensitivity	4	0
11. possessing the disposition to solve problems	2	1
12. recognizing effect of emotion on thinking	1	0

* From 19 science educators (writing in 15 sources) giving some of the above attitudes as science objectives.

A further study of Tables I and II also indicates that more attention and emphasis has been given to the development of abilities than to the development of attitudes.

The investigation did reveal, however, that there were some classroom procedures which had been suggested in the light of more general objectives such as "developing thinking." These were not included in the tabulation since their number was small and their interpretation was too general for the purposes of this analysis.

TABLE II

SUMMARY OF FINDINGS CONCERNING ABILITIES *

Recognized Ability to:	Number of Sources giving Ability as Science Objective	Number of Sources Suggesting Classroom Procedure with Objective
1. handle data	11	1
2. appraise problems and errors	9	2
3. plan and organize	9	2
4. formulate and test hypotheses	9	1
5. use deductive methods	8	2
6. use materials	6	2
7. observe accurately	5	1
8. handle assumptions	5	1
9. use inductive methods	5	0
10. use language	4	2
11. recall selectively	3	0

* From 21 science educators (writing in 17 sources) giving some of the above abilities as science objectives.

The following are some additional conclusions which were made from the study:

(1) Although most of the suggested classroom procedures included a proposed form of evaluation, relatively few writers gave adequate attention to this phase of their classroom procedures.

(2) Relatively few classroom procedures were designed to require practice in the transfer of some of these attitudes and abilities to problem situations beyond the immediate field of science.

Some recommendations proposed on the basis of this investigation included:

(1) There is a need for more development and experimentation in classroom procedures and in the evaluation of their results in terms of desirable objectives related to "thinking" in secondary science instruction.

(2) There is a need for the development of transitional techniques with which teachers may experiment in order to initiate these or other procedures in their classrooms.

(3) Secondary science "methods" books should contain more illustrations of suggested classroom procedures which could be used by teachers as a basis for further experimentation.

(4) Although there are a number of tests available for appraising some factors in the "thinking" process, there seems to be a need for unifying objectives, teaching procedures, and evaluation techniques. In a number of cases, these elements of the educative process have been artificially divorced as if they operated independently of each other.

The following illustrations are given as some examples of suggested classroom procedures:

1. *Attitude of Problem Sensitivity*

   a. *Classroom Procedure*

   Prior to the showing of a film, one might attempt to have the class forecast the contents of a film from its title. Thus, the teacher could ask the class to set up some standards or criteria (list on board) by which the students could judge the film (e.g. simple explanations, understandable illustrations, satisfactory vocabulary level, etc.)

   After the film showing, students would be asked for their comments on how well the film met their standards? Were there other criteria which students would add to their list? Would they recommend the film for future classes? Why? What additional problems did the film raise in their minds? What problems did the film answer?

   b. *Proposed Form of Evaluation:*

   Oral class discussion and questioning; individual evaluation of film could also be done by means of short, written "essay" type questions.

2. *Ability to appraise problems and errors*

   a. *Classroom Procedure*

   A news clipping of the following type can be used effectively to see whether students can appraise a problem situation in terms of scientific principles. (The clipping is read to a class in High School Physics.)

   FAST TRAIN PULLS 3 WOMEN TO DEATH UNDER WHEELS

   Three women were killed yesterday when they were drawn against the side of a fast passenger train as they were standing on a station platform. Two men were hurt . . . the victims were waiting for another train. A fireman on a train standing nearby told police he tried to warn them because they were standing too near the track. Hometown police are making an investigation since there is a speed limit of 40 mph for trains. Fast trains create a suction as they pass by. . . .

   "After hearing the details of this incident, what would you say was the cause of this accident in terms of physical principles? What is meant by 'suction?' Do you see any relationship between this situation and that which occurs when using a flit gun in your closet at home?" (Bernoulli's principle)

   b. *Proposed Form of Evaluation:* Class questioning and discussion; the use of a similar type of problem on a subsequent test.

If science teachers are sincerely concerned with the development of student "thinking" and if they wish to implement goals through practice should they not strive to provide opportunities for such activities in their classroom procedures?

In closing, it might be well to add that suggested classroom procedures should be guides to active experimentation and not merely rigid or convenient methods of freezing class processes. How else can the teacher of science best exemplify his field of endeavor but in terms of experimental teaching practices?

THE SCHOOL TODAY: IS IT MEETING MY EDUCATIONAL NEEDS? *

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THE school today: Is it meeting my educational needs? That is the question so often asked today by high school students who are seriously studying what is in store for them after they put their school books away and shoulder the responsibilities handed down to them by the founders of our precious American heritage. I am one of those students. I am concerned about my future. I want to be able to take my place among the leaders of our nation with squared shoulders, confident that I have had the fundamental training I need to help protect and preserve our great democracy. I want to know I am qualified to meet the challenge of my country.

That challenge is tremendous. It is not one that can be attained and surmounted through hard work and then forgotten. It will live on, and continue to grow even after the great names of our country today are written in the eternal pages of history. To stand before this challenge in a few years without flinching we need educational opportunities now; and even more important, we need an understanding of the principles in which we so fully believe, an understanding without which no free and democratic nation can survive.

Modern schooling is giving us these educational opportunities in such a manner that today it has become the greatest stepping stone of our lives—the bulwark between ignorant despotism and free civilization.

Teaching us the "Three R's" is as basic and essential in our schools today as it was in Grandfather's time, for as Francis Bacon so aptly phrased it, "Reading maketh a full man, conference a ready man, and writing, an exact man." These classes today, however, are taught to us in a much broader and enlightening fashion. Besides the required subjects the schools are helping us choose a career for which we are best suited, and providing courses designed to give us practical experience in the profession we select. The schools have classes for the enrichment of the student's cultural knowledge. Art, music (the universal language), drama, sports, and a number of others add pleasure to the school curriculum.

Today world peace and friendship mean more to us than at any time in history; and what promotes this aim better than the foreign languages taught in our schools. To understand a country, its principles, and its beliefs we first need to know and understand the language spoken by its people. Geography and history also play vitally important roles by teaching where and how other people live, how great civilizations reached their zeniths and then crumbled to ruins, and how these downfalls were met with the rise of other great empires. And equally important, we are learning where mistakes were made in the past and how we can avoid those mistakes in the building of our great American dream. Yes, from these classes and similar ones we are learning one of the greatest lessons of all times—how to "Work Together for World Understanding."

Up to now I have mentioned the material values we receive in our schools; values that I consider are definitely meeting my educational needs. However, after I finish my schooling—no, I won't say "finish," for life itself is a school, but after my high school and college days are over, I not only want to have broadened my horizons mentally; I want to have had my moral character broadened and strengthened also.

* Editor's Note: Winning Essay among nearly 10,000 submitted in *Miami Herald's* eighth annual high school contest. Winner receives $1800 four-year college scholarship.

Without high ideals, (which we develop, to a great extent, in school), my educational opportunities are going to be tragically wasted, for thinking only for one's self, and working only for personal gain is violating the very essence of love and brotherhood—the main reasons He placed mankind on earth.

In our nation's capital stands a fitting memorial to one of America's greatest statesmen, Thomas Jefferson, whose words were spurred with the fire of his belief in personal moral and religious freedoms, whose wisdom stands out as a symbol of everlasting meaning to those who dedicate their lives to the ultimate goal of a free world. On a frieze encircling the center of the memorial are inscribed his immortal words: "I have sworn on the altar of God eternal hostility to every form of tyranny over the mind of man." Americans can be thankful and humble that their schools are teaching against "tyranny over the mind of man," for in many countries school children's minds are being inhumanly warped by leaders who advocate this tyranny. Perfect examples are the Polish schools today. At the opening of a Society of the Friends of Children school near Warsaw in October, Witold Jarosinski, Minister of Education in Poland, announced that the school children will be brought up according to Marxian and atheistic principles, and will be prepared to fight a class war against superstitions (religious faiths and beliefs), and against reaction. The teachings of Marx and Lenin as the foundation of all studies make most parents unwilling to send their children to school, but terror tactics leave the parents hardly any choice.

Compare the teachings in the Polish schools with ours in America. Are we disciplined, through force, to believe and agree with the statements of our leaders? Are we terrorized into abandoning our religious faiths? Are our minds being brutally misshapen and molded like so much clay to think the way we are told to think, to speak the things we are told to speak? No, these things are not true in our American schools, and with the light of Almighty God guiding our path they never shall be. Our schools are teaching us to think for ourselves, to have initiative, courage, faith, integrity. Every school activity, regardless of its importance, is teaching us to face problems wisely, to seek the truth, to sort out and weigh opinions, to have respect for other people's ideals, to honor other races, other creeds, other beliefs, to participate and co-operate in getting things done. Surely these things we are learning, mentally and morally, are meeting, and will meet, our educational needs, for one cannot live without learning, and one cannot learn without growing in wisdom and maturity.

The guardians and protectors of our great American heritage are in the nation's schools today. Thirty-three million boys and girls are devoting approximately one-fifth of their lifetime to the gathering of the richest treasure known to man, education; and not one of these students will truthfully deny that he is being given every possible opportunity to learn, and to grow, for his—and his country's—future.

BOOK REVIEWS

ROSENHEIM, LUCILE G. *Kathie the New Teacher.* New York: Julian Messner, Inc., 1950. 195 p. $2.50.

As do all beginning teachers Kathie Kerber had many new problems to solve during her first year as seventh grade social studies teacher at Hill Crest. Impulsive, friendly, imaginative Kathie had many problems, many of her own making in her debut as a teacher. But her assets far outweighed her shortcomings and one wishes that every teacher could have her enthusiasm, her broadmindedness, and her intense, sincere love and understanding of children. Teaching to her was not merely a job with a pay envelope but the greatest task a person could ever set themselves to do.

The quotation below rather characterizes Kathie—her whole attitude toward home and the pupils she loved—whom she admitted she could never deal with objectively and intellectually only—but with her heart.

"This was home. This was being cherished and wanted, and there was no sweeter comfort in the world. It was a sharing of tenderness and warmth and love that she would need and appreciate always, that she would never, never outgrow."

Altogether this is one of the finest supplementary, narrative books I've ever read about the teaching profession. It would serve excellently as a career book, for a "common learnings" course, and as a supplementary book for introductory courses in education when young preteachers are being initiated into the professional aspects of their training. Read it and weep and thrill with Kathie as she has more than the usual ups and downs of a beginning teacher.

EATON, JEANETTE. *Gandhi: Fighter Without a Sword.* New York: William Morrow and Company, 1950. 253 p. $3.00.

Mohandas Gandhi, one of the world's greatest figures, has already become a legend. Without doubt his name and fame were known by more people than any other man of the twentieth century. In fact many consider Gandhi the greatest man and the name most likely to live on of those living in the first half of this century.

Born well to do, Gandhi as a young man adopted the austere way of living that was his until the day he died. He did not want comforts and luxuries when so many of his countrymen lived in terrible poverty. He ate only the most frugal meals and in his later years wore a peasant's costume. Yet to him life was a joy and a pleasure.

It was in South Africa that he first became the champion of countless millions of downtrodden Indian workers; *Mahatma,* the name by which he became best known over the world, means *Great Soul.* He lived a life of peace by passive resistance and after a life-long fight, often reinforced and emphasized by fasting, his beloved India finally won freedom from England. But he was deeply grieved by the break away of Pakistan when he so much wanted their unification. He took Untouchables into his own home as part of his effort to abolish the evil custom which made outcasts of millions of Indians. He tried to unite Hindus and Mohammedans but eventually realized the futility of such effort. But this peace-loving, gentle soul whose life and teachings were always the very antithesis of violence, was himself destined to die at the hands of a young fanatical Hindu on January 30, 1948. Thus ended the life of one of the greatest souls of all time—hero, saint, and man.

EMERY, GUY. *Robert E. Lee.* New York: Julian Messner, Inc., 1951. 176 p. $2.75.

This is the unforgettable story of a soldier who had to choose between two loyalties—his country and his family. After thirty years of distinguished service in the U. S. Army, Colonel Robert E. Lee refused the field command of the U. S. Forces because he could not fight against friends, cousins, and his own two sons who had volunteered to defend their native state in the Army of Virginia. But had Lee accepted command of the U. S. Forces there might not have been a Civil War even, or in case it had gone on as it did, the war might have been rapidly brought to an end. Probably most students of American history agree that Lee was the outstanding general of the war and had his army had the food, clothing, and fighting equipment of the North and had he been left alone by President Davis, Lee might readily have been victorious. Personally, Lee had few if any bad habits. He did not smoke, drink, or swear, and had exceptionally great control over his emotions and temper. Colonel Emery, himself, trained at West Point, depicts Lee's almost irresistible power over men and material alike. "It had been bottled up—concentrated—within the man through his whole life because he never allowed the least of it to dissipate itself, in one single self-serving act."

HARTWELL, SAMUEL W. *A Citizen's Handbook of Sexual Abnormalities.* Washington, D. C.: Public Affairs Press, 1951. 71 p. $1.00.

This is a report of Governor G. Mennen Williams of Michigan Commission on Sex Deviates. It presents a mental hygiene approach to the prevention of sexual abnormalities. The report seems to be quite comprehensive and takes cognizance of legal as well as practical conditions. The author has an M.D. degree and is assistant Director of the Michigan Department of Mental Health.

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